Fundamentals of High-Voltage Insulation Design—*A Simple Method of Correlating Mechanical and Magnetic Properties of Steel* and other articles dealing especially with engineering subjects

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Electrical World

New York, February 17, 1917 McGraw Publishing Co. Inc. Vol. 69, No. 7 10c a copy

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Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company Inc.

Vol. 69 NEW YORK, SATURDAY, FEBRUARY 17, 1917 No. 7

Edison at Seventy

THIS headline does not, somehow, read right, for though celebrating his seventieth birthday on Sunday, Feb. 11, Edison still carries with him the very air and spirit of youth and electricity. Reaching the limit proverbially ascribed for a ripe old age, the great electrical inventor still pushes forward so ardently into new fields and throws himself so eagerly upon the new tasks of the onward-looking times, that one might well credit him with possessing the secret of perennial juvenility. As a matter of fact, Edison can never grow old; and the fact that his physical body should have to admit that it is three score years and ten seems almost like a whimsical indiscretion. His energy and tireless example, his genius and fertility, his ability to create and to turn his creations into new arts and useful industries, his cheerful serenity of soul under every disaster and discouragement—these have shaped him into an ideal which has won a world-wide recognition and which adds to the luster of American achievement and character. There are now three February birthdays in the celebration of which national pride may well find expression; two of immortal presidents and the other of one of the greatest benefactors of the human race.

The House in Good Order

POSSIBILITIES of international complication find the electric central station house in good financial order. Floating debts have been paid or cut down. Thanks to the good bond market the companies have been able to sell securities at excellent prices and have provided generally for their necessities for expansion. Large earnings met the bond dealers' requirements of a strong financial statement. Banking caution has counseled conservatism in the expansion of properties. And added to banking caution has been the shortage and high price level of raw materials. Therefore we do not look for radical change in the electric central station financial position. These properties are utilities which go steadily ahead; they are affected less by adverse business developments than other classes; they are not affected as suddenly as other forms of business. It is more from the operating side of the industry that reactions from international disturbance are expected. As was pointed out in last week's issue, intensified coal shortage is a dangerous possibility. If this develops it will demand forethought, co-operation and positive action, not only on the part of individual managers, but by the entire central station industry.

The Engineer and the Crisis

THE hour has struck and the nation wakes to face at least the possibility of entering the tremendous struggle which is rending civilization with a ferocity unparalleled even in the Dark Ages. Hostilities do not necessarily follow a breach in diplomatic relations, but a breach arising from two years of intolerable exasperation is not easily healed. And nothing save a sincere and complete reversion of purpose, which must be regarded as rather improbable, can avert actual warfare. If it comes, the engineer must rise to the occasion with an alertness and vigilance unequaled in military history. The situation is a singular one. The United States is safe from the major operations of a hostile navy, because that navy is hopelessly bottled up by superior force, and our own navy is almost equally powerless for aggression. Neither the United States nor Germany can make use of an invading army so that the probable hostilities are practically limited to those between marauding submarines and the defensive fleet on the water or in the air. The war, if it comes, will be a war of wits, of ingenuity and resourcefulness.

Right here is a field for the united engineering abilities which the country can muster; for a design of adequate defenses against the utmost technical skill and daring that submarine warfare can disclose. Much has already been done by the Allies, with some material help from American genius, in devising means for meeting the new danger. It is a curious problem, that of blocking the torpedo attacks of an unseen foe, and of finding and destroying that foe wherever it wanders. The art of trapping and countermining submarines is already somewhat developed, though it needs perfecting at the hands of American engineers, but traps and snares are not all of the hunter's business, and the greatest need lies in developing a successful method of still hunting, trailing an unseen boat through the pathless fields of the sea, finding and destroying it. All the ingenuity that can be put on submarine detectors is needed now and in the future, and this is the biggest single task that lies before the American engineer and inventor. A submarine, like a seal, has to come up to breathe, and incidentally to charge the storage batteries for further under-water operations. If electrical or other means can be found for detecting the presence of and locating, even roughly, the neighborhood of a submarine a long step will be taken toward immunity.

The task then, of destruction, resolves itself into the practice of the Eskimo hunter, waiting patiently, spear in hand, at a hole in the ice, until some unhappy seal finally comes up for a breath of air and gets the spear

point. Just so might a light cruiser lurk and listen, if able to sense the presence of her prey, until a periscope or a conning tower breaks water and the rapid fire guns begin their chatter. No great harm if they miss at first, for the pirate crew below can take their choice between going down under a storm of shell if they rise, or staying down and suffocating. Almost equally important are the possibilities of the air service, and its equipment with means for more readily locating the submarine, which cannot look above to see its foe, and yet may disclose itself to the vigilant watchers. Once located it may be a case of signalling to a convoying destroyer to take up the scent, or perhaps of the hawk's swoop with a hundred pounds of high explosive instead of talons. These and similar problems must be solved for the sake of the not distant future even if hostilities should be for the present averted. This work of submarine defense is one that calls for all the skill and ingenuity that the engineering profession can muster, and that skill cannot be bent to any end more useful in the country's service.

The Uses of Reactors

THE convention of the American Institute of Electrical Engineers held this week in New York disclosed two very interesting studies of the employment of reactors in the large stations and their protective effect in case of accident. The development of the principles of reactive protection has been a rather long one. In the beginning of power transmission work there was a strong feeling that for stability and good regulation machines of low reactance were desirable, as indeed upon general principles they were; but it soon became evident that not only were low reactance generators somewhat expensive to build, but they were particularly subject to injury in case of short-circuits, and while they would run admirably in parallel if carefully handled, they were liable to exchange at times a great deal more current than one would wish. Further, as automatic regulating apparatus developed, the need for low inherent regulation diminished, so that standard types of generators soon acquired sufficient reactance advantageously to limit the short-circuit current and the aspirations of current interchange in parallel running. At a very early day, too, the use of main line reactors in connection with lightning arresters showed its usefulness, but as machines became bigger and bigger, and stations grew to larger capacity, the dangers of short-circuits and the difficulties of switching increased in a somewhat astonishing ratio and the modern reactor found a most useful place. When used in sectionalizing a bus, for instance, reactors are of great value in keeping down short-circuits, and wherever employed act as limit valves in keeping down dangerous currents.

Of the two papers presented before the institute, that of Mr. Junhke gives a vivid account of the serviceable quality of the reactor system in a serious cable breakdown near one of the great generating plants of the Commonwealth Edison Company. Cables do break down, and when the break is near a big station considerable damage may be done before the automatic apparatus can clear the lines. In this instance, before the disconnecting circuit breakers had finished their work 80,000 kw. of system load had been cut out. The details of the accident were carefully examined, and it was found that the short-circuit had produced sufficient mechanical forces on the cables to disrupt connections at an oil switch, which still further complicated the situation. The disturbance was severely felt over the entire system, with a generating capacity of more than a quarter of a million kilowatts and a load of about 200,000 kw. Investigation showed that the maximum short-circuit current poured into the fault was something like 58,000 amp. Had the reactors not been in circuit to limit the feeding in of energy to the fault the total short-circuit current would have been nearly double that amount, which would have put an instantaneous thrust of more than 1000 lb. per foot on some of the parallel conductors involved, which might have wrecked portions of the switchboard besides putting an enormous and perhaps impossible overload on the oil switches. With all these tremendous electrical mechanical strains not a single piece of generating apparatus was disabled, quite contrary to the situation before reactors were installed. With the reactors in service the interruption proved exceedingly short, one section losing about 50,000 kw. for five minutes and the other sections much less and for shorter periods. The incident seems to be a very complete demonstration of the value of reactors, especially in the great inter-connected distribution systems that form a part of the service of every large city.

The second paper, by Mr. Johnson, deals with the similar use of the reactors in hydroelectric stations. The advantages gained here are the same as in the case just mentioned, though their presence protects the machinery from enormously heavy short-circuits, and also assists greatly in localizing whatever disturbances may exist. It is found that a comparatively moderate amount of reactance gives good results in these particulars, but that it is unwise to push this kind of protection too far on account of the effect of increased reactance on the system upon the stability of synchronism and on the power surge. It is quite possible, as will be readily seen, to increase the reactance up to a point where there is serious instability in case of a sudden disturbance, enough even to throw machines out of phase. In fact, amounts less than this will sometimes produce instability enough to cause hunting of apparatus in parallel, sometimes rather difficult to control.

Mr. Johnson gives a very instructive discussion of this very practical case, illustrating it by a striking example of the effect of a surge in a station containing four groups of large generators with about 12 per cent reactance between the groups. In this case a surge was started by suddenly dropping a load of about 20,000 kw. from one bus section, and involved all the sections until the circuit breakers were opened. The instability was sufficient to start violent hunting with the power surging back and forth at a period of about one second,

not quite enough to trip the overload relays set for one second time limit, while the turbine governors in endeavoring to catch up with the situation made it worse. It is therefore clear that somewhat careful investigation of the reduction of stability by reactance is desirable before their amount is determined, and it looks very much as though a compromise must generally be made between the amount of inductance which would be desirable for protection alone and that which is safe from the standpoint of stability. Mr. Johnson's paper contains data for the examination of this condition, and is worth the serious study of engineers who are dealing with large power stations involving a parallel operation of many units. We cannot leave the subject finally without hinting that it is possible to overwork the principle of parallel operation at the busbars, however theoretically beautiful it must seem. There are cases, particularly in power transmission, when it is not bad policy to cut feeders loose from direct connection with each other and parallel them through a distant connection, for a long line is sometimes a very valuable buffer.

Permeameter for Testing Steel

THE properties of steel alloys, or grades of steel; are becoming of increasing importance in construction, and in the manufacture of tools. These properties become the more important, in view of the precision with which the chemical and physical treatment of steel can be controlled and predetermined in the modern steel furnaces. Some of the properties of these steels can only be determined by chemical or mechanical tests. A few of them are capable, however, of being determined by magnetic tests. In order to apply a magnetic test, it is only necessary to provide a short bar or prism of the material, and to insert it in a suitable permeameter.

The article by Frank P. Fahy on page 315 describes a convenient form of permeameter which, while capable of being used for the measurements of permeability and of hysteresis in a single sample bar, is particularly adapted for the speedy comparison of the permeability of a sample bar with that of a known standard bar. For most purposes of the shop or factory, it is the comparative measurement, rather than the absolute measurement, which is in greatest demand. In order to measure the absolute permeability or hysteresis in a sample bar, with engineering precision, many precautions have to be taken to avoid errors; but in order merely to compare these quantities in a sample bar and in a standard bar, most of these sources of error can be eliminated in a good form of permeameter.

Insulation of High-Voltage Transformers

THE development of high-voltage systems and apparatus has rendered necessary the study of the electrostatic circuit; just as the development of the dynamo machine necessitated the study of the magnetic circuit. An essential difference between the two circuits is that whereas the magnetic circuit comprises closed loops of magnetic flux, each magnetic flux loop forming an endless chain, the electric circuit ordinarily is incomplete or is completed through a conducting source, electric flux being conceived of as issuing from a positive charge and terminating upon a negative charge.

Prof. Alfred Still contributes a useful article to this number, on the principles and practice of the electric design of transformer terminals. In the evolution of transformer design the first step was the working of the magnetic material up to a suitable predetermined value. The next was the thermal working of the structure, so as to control the temperature elevations under load. More recently, mechanical stresses under overload conditions have had to be recognized and protected against. Finally, dielectric stresses have had to be computed and guarded against. The completed modern transformer in a high-tension system is one in which magnetic, thermal, mechanical and electric stresses are all taken into account, preregulated, and guarded against, the materials being worked at suitable densities of magnetic, thermal, mechanical and electrical flux.

The laws of electric flux are somewhat more complicated than those of magnetic flux, owing to peculiar difficulties in securing perfectly homogeneous dielectrics. Moreover, some of the phenomena of leakage and ionization occurring with dielectric stresses, have no counterparts in magnetics. For these reasons, dielectric design is more complicated and troublesome than magnetic design. Professor Still's article is directed both to the theoretical and practical sides of the subject, and is worthy of careful consideration by students of transformer design.

The Coming Issues

NEXT week in the commercial number of the ELECTRICAL WORLD for February, one of the leading articles of the issue will treat of a method of analysis of the central station's load as a guide to greater effectiveness in future commercial effort, pointing out how emphasis upon certain kinds of new business can be made to work an improvement in load-factor conditions. Another contribution to this number places an interesting aspect on the effect which the increasing efficiency of incandescent lamp sources may be expected to have on the central station's lighting business and the relation of the lighting load to the other principal classes of central station business. Additional articles on the subject of foreign-trade expansion for electrical manufacturers and jobbers, to which the ELECTRICAL WORLD has already given considerable attention in the past, will also be presented in the Feb. 24 number. Besides these commercial features the number will contain the regular departments for the engineer and operating man. For the electrical commercial man interested in detail merchandising methods, ELECTRICAL MERCHANDISING for this month, issued Feb. 15, contains a number of timely ideas and plans for house-wiring business, together with an important and useful new section on store equipment and store methods and plans for selling vacuum cleaners and other appliances.

The 210,000-Kw. Buffalo Steam Station—III

Features of Turbo-Generator and Condenser Operation Together with Arrangements and Connections of Switching and Protective Apparatus

SECTIONS of this article have appeared in the Jan. 27 and Feb. 3 issues of the ELECTRICAL WORLD. The first installment contained a description of the coal-handling and firing apparatus and boiler equipment. The second article described the construction and operating features of the steam end of the station dealing especially with the economizers, make-up water evaporators, steam piping and method of maintaining a balanced draft. This section, which is the final one, contains a discussion of the electrical features of the station, including the main turbo-generators, switching and protective equipment.

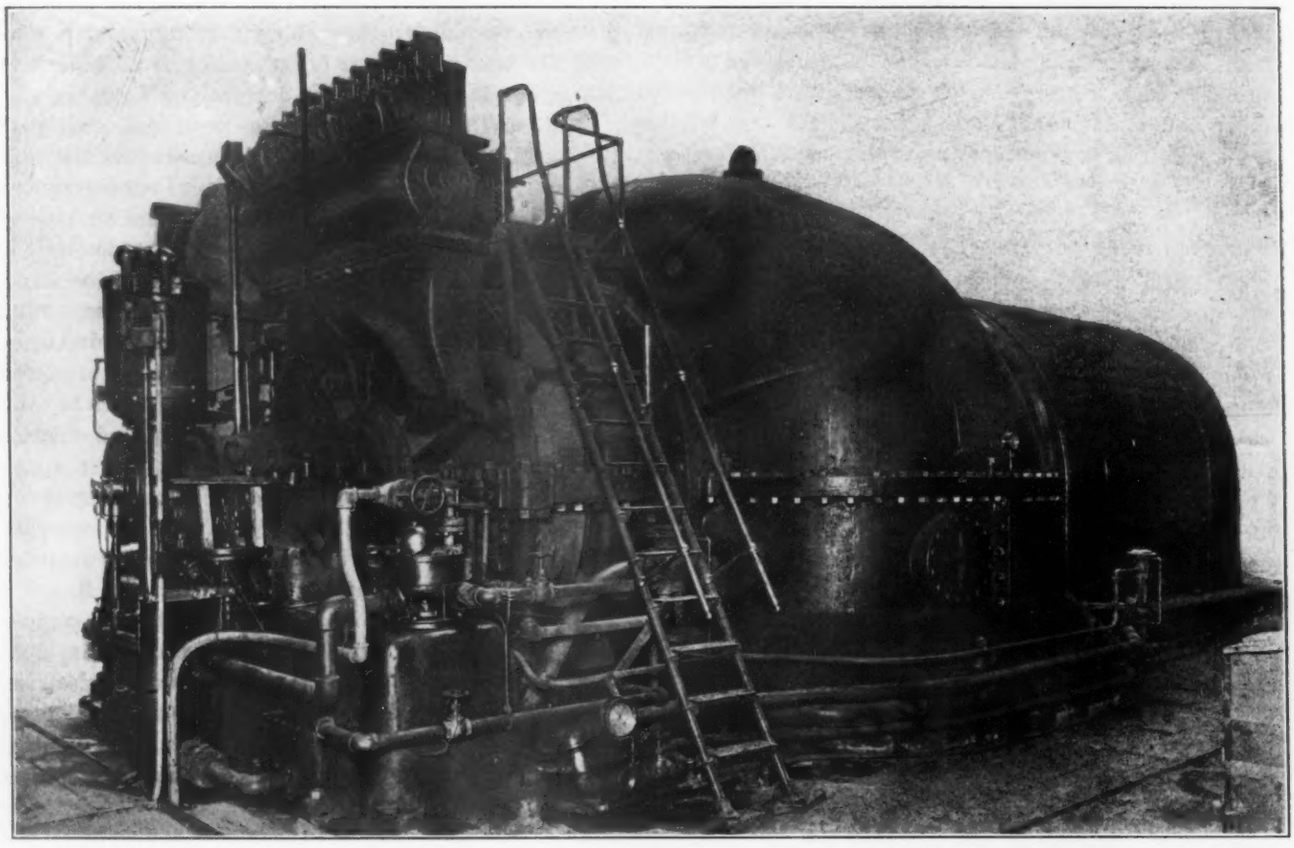


FIG. 1—ONE OF THREE 20,000-KW. TURBO-GENERATORS INSTALLED IN THE BUFFALO STATION

At present three 22,222-kva., 12,000-volt, three-phase, 25-cycle, two-pole General Electric generators driven by horizontal turbines are installed in the station. The turbines are designed to operate at 250 lb. pressure and at 250 deg. superheat, the steam temperature under these conditions at the throttle being 656 deg. Each turbine is provided with a 10-in. low-pressure connection so that steam from the auxiliaries may be introduced when necessary to obtain a station heat balance. Solenoid-operated trips are connected with the main throttle, auxiliary throttle and vacuum breaker of each unit so that the opening of the main generator circuit will simultaneously shut off all steam from the machine and destroy the vacuum. Schutte & Koerting trip valves and vacuum breakers are in service, the solenoids being operated by 125-volt direct current, the electric release in no way interfering with the usual mechanical trip gear.

The condensing equipment for each turbine, which was furnished by the Westinghouse Electric & Manufacturing Company, consists of a 33,000 sq. ft. surface condenser with two 25,000 gal. per minute circulating pumps, two hot-well pumps and one double LeBlanc air pump, all turbine driven. The condensers are of the straight down-flow type. A portion of the tubes nearest the steam inlet is utilized as a primary heater through which the condensate is pumped before going to the feed-water heater, this arrangement permitting of the condensate being heated to a temperature very nearly equal to that of the exhaust steam. The system of spring supports used makes it unnecessary to have an expansion joint located between the turbine exhaust and the condenser steam inlet. On account of the slight movement of the condenser with expansion, provision for this movement has been made in the layout of all piping to the condenser.

The circulating water pumps are of the horizontal double suction, centrifugal type, each direct connected through herringbone reduction gearing to a horizontal, non-condensing steam turbine. Under winter conditions it is expected that one circulating pump per unit will suffice. Both pumps running together are capable of circulating 40,000 gal. per minute under normal head conditions. The turbines and pumps are so designed that either unit can be speeded up to start the system working with the siphon broken at the discharge outlet of the condenser. The hot-well pumps are of the hori-

zontal, two-stage centrifugal type, each direct connected to a horizontal non-condensing turbine. Each pump when running alone is capable of removing the total condensate from the condenser when the latter is operating under maximum load and discharging against an external head of 80 ft. Two LeBlanc pumps are mounted on the same shaft with the driving turbine and operated at 2500 r.p.m. The auxiliary turbines are designed to operate with a steam pressure of 275 lb. and 275 deg. superheat, the back pressure being about 18 lb. per square inch absolute. They have sufficient capacity, however, to carry their full load when supplied with saturated steam at 200 lb. gage pressure. Each main turbine is provided with the usual free-exhaust outlet, located near the top of the condenser and discharging through a 36-in. spiral riveted galvanized-iron riser carried to the roof through the boiler house. The atmospheric relief valve is located in a horizontal run between the condenser and the riser.

Along the water front parallel to the building is an open intake flume. At one end is an intake and screen well divided into four compartments provided with racks at the entrance and removable screens located farther back. The main discharge tunnel extends alongside of the intake well and between the latter and the building, discharging into the river a suitable distance downstream from the intake. From each unit in the station the discharge tunnel is carried directly over the intake tunnel, the individual intake tunnels crossing under the main discharge tunnel. At the south end of the intake compartments is a by-pass tunnel connecting with the main discharge tunnel. The by-pass may be opened in cold weather in order to allow warm discharge water to flow in front of the intake and prevent freezing at the racks. In very cold weather a large part of the total discharge water may be directed through this passage by closing off enough of the main discharge tunnel to the river. Stop logs are provided in the tunnel connections to each unit, so that any one may be shut off for cleaning or repairs. All tunnels and wells are reinforced concrete.

Three 300-kw. Terry combination turbine and induction motor-driven exciters are installed in the main turbine room, but at present one unit is located on the basement floor pending the installation of the fourth main generating set. Normally the motor drives the exciter in each set, but in case the speed falls 4 per cent or more, the turbine governor automatically throws the load upon the turbine and thus maintains the speed. In case of trouble on the main circuits, the exciters can be depended upon to take care of themselves without attention, freeing the operators for other duties. In case the load conditions permit the economical use of the exciter turbine exhaust in the heaters, it is possible to operate at a higher all-day efficiency than with either a straight motor-driven or steam-driven exciter, as the drive can be shifted to the motor during periods of light load, while under heavy loads with large demand for exhaust steam for feed-water heating the turbine drive can be cut in, thus insuring maximum economy of operation.

A complete permanent testing plant is a feature of this station. On account of the use of hydraulic dry vacuum pumps for all three main condensers, it was necessary to install a rotating dry vacuum pump to allow tests being made on the condensers. A gasometer is provided so that volumetric tests can be made at any time. The central testing system for station auxiliaries includes a 1400-sq. ft. surface condenser, so arranged that the exhaust from any of the auxiliaries may be condensed, and a weir for measuring this condensate, checking up boiler feed, hot-well discharge, etc. An automatic coal-sampling plant is located in the coal-elevating tower, a separate sampler and crusher being provided for each elevator.

The main generators are self-ventilating, drawing 45,000 cu. ft. of air per minute through basement ducts leading from louvers at the outside of the building to the machine casings. As stated in a previous section of this article, heated air from the generators is discharged

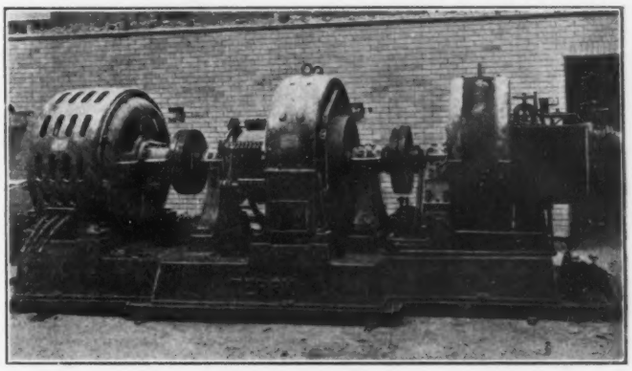


FIG. 2—COMBINED TURBINE-MOTOR-DRIVEN EXCITER

from the main units into the forced-draft fans supplying air to the boiler furnaces. Hand-operated dampers are provided in the generator cooling air intake ducts so the air supply may be shut off in case of a generator burnout. These dampers are equipped with alarm signals to warn if they are accidentally closed. Space is allowed for the future installation of air washers. The ducts are screened to prevent entrance of insects. Six sets of temperature coils are installed in the stator windings of the main generators, with the usual connections to indicating instruments on the switchboard.

Just off the turbine room is a six-story switch and bus section, which is 35 ft. wide and extends the entire length of the building. The main switchboard equipment is located on the fifth floor, reactors, switches and buses occupying floors below, as indicated in the accompanying cross-sectional drawing. The generators are connected to the outgoing feeders, as illustrated in the

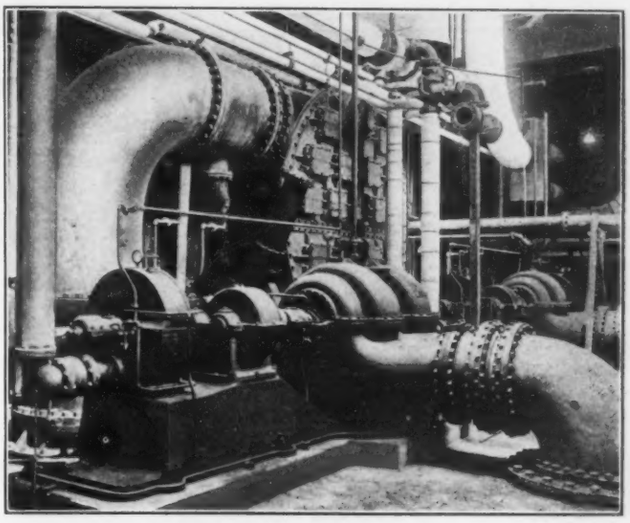


FIG. 3—ARRANGEMENT OF TURBINE-DRIVEN CIRCULATING PUMPS

accompanying wiring diagram, no main transformers being required. The delivery of energy at line voltage and the moderate voltage involved, namely, 12,000, simplified the electrical design with respect to conductor spacing and transformers; but on the other hand, the great number of outgoing feeders involved and arrangements for providing flexible and uninterrupted service

necessitated liberal space provision for housing the electrical equipment in a symmetrical manner.

Each generator is connected through disconnecting and non-automatic oil switches to a reactor bus. From this bus connections are made through 2 per cent synchronizing reactors and oil switches to a common synchronizing or transfer bus and through 5 per cent main

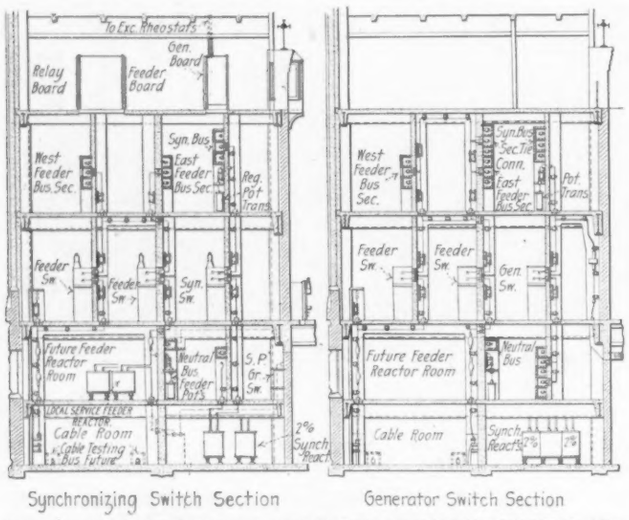


FIG. 4—ARRANGEMENT OF APPARATUS IN SYNCHRONIZING AND GENERATOR SWITCH SECTIONS

or generator reactors and non-automatic selector oil switches to sectionalized feeder buses. Separate feeder-bus sections are provided for each generator, these sections being in duplicate and so arranged that any section of the main wiring may be disconnected for repairs without interfering with the service. Arrangements are made to permit the future installation of twelve feeders (total) from each feeder bus. Each feeder is connected through an automatic oil switch and provision is made for the installation of feeder reactors when the generating capacity of the plant is increased. Duplicates of any of the oil switches may be installed and connected to parallel by utilizing spaces provided for

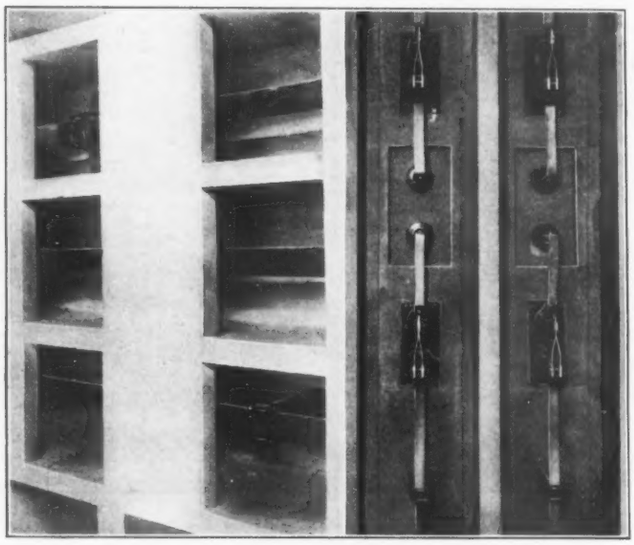


FIG. 5—SECTION OF 11,000-VOLT BUSBAR COMPARTMENT AND ARRANGEMENT OF OIL DISCONNECTING SWITCHES

feeder switches and reducing the number of feeders. This arrangement will probably never be required for the main switches, but may be found desirable for important feeders where repairs to an oil switch, instrument transformers or reactors would interrupt service.

A static discharger is connected to each feeder-bus section through expulsion-type fuses. Provision is made for connecting the end feeder sections together through an oil switch by a ring bus. For the present, disconnecting switches and a short section of the ring bus are provided for connecting the first two feeder sections, thus providing two means of supplying energy to the present end feeder bus. The neutral connection of the Y-wound generators is brought out and grounded through an oil switch and 5-ohm resistor.

Each exciter is capable of exciting all three gener-

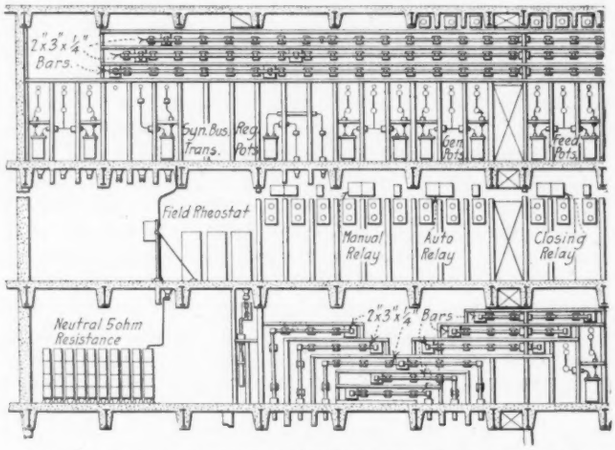


FIG. 6—BUS AND SWITCH ARRANGEMENTS IN GENERATOR SWITCH SECTION

ators. The units are connected to a sectionalized single bus through remote-control, electrically operated circuit breakers. Field connections are also made through remote-control, electrically operated circuit breakers and motor-operated field rheostats. Space is provided for the installation of a second exciter bus. Energy for driving the exciters and other auxiliaries is obtained from two banks of step-down transformers, either bank being sufficient for the service. Duplicate transformers are provided for lighting service. These transformers are supplied through oil switches from a 12,000-volt sectionalized bus, which in turn is supplied through two feeder oil switches, one of which is connected to the synchronizing bus and the other to the third section of feeder bus. The low-tension sides of the transformers energize a sectionalized bus to which the exciter motors, station auxiliaries, distributing panels and lighting transformer circuits are connected through oil switches. Knife selector switches are provided for connecting lighting transformers to either section of a low-tension bus. A similar provision is made for connecting any auxiliary distributing panel through the oil switch of any other auxiliary panel.

All six terminals of each generator's windings are connected with current transformers, which trip the main generator, neutral and field switches, and the throttle, mixed pressure and vacuum valves on the turbine through the medium of a relay and auxiliary switches in case the armature windings break down. A second relay is placed in the trip circuit for the control switch. This is connected to trip the generator oil switch and throttle, mixed pressure and vacuum valves.

The generator leads are provided with varnished cambric insulation and are carried in concrete-incased fiber duct suspended from the turbine room floor. In the electrical bay they are connected to strap copper buses. Beyond this point all main conductors are of strap copper segregated by barriers and carried on busbar supports supplied by the Philadelphia Electric Company.

A length of 45 ft. per generating unit is provided in

the electrical bay. The bay is divided into two vertical sections by a 12-in. reinforced concrete supporting wall extending up to the switchboard floor. In addition, there are 8-in. reinforced concrete walls for supporting buses and conductors and for segregating the electrical equipment. Each 45-ft. length is separated from the adjacent units by a 4-in. reinforced concrete wall, all passageways in which are provided with fire doors. Where conductors pass through walls or floors porcelain bushings set in sandstone slabs are provided, thus completely segregating the equipment in separate rooms. The rooms containing the main and synchronizing reactors are provided with forced ventilation to carry off the heat liberated from the reactor coils. All other rooms are ventilated by a natural draft system of ventilating ducts terminating in roof monitors.

All main switch cells are made of reinforced concrete, the barriers and bus compartments consisting of sandstone slabs 2.5 or 4 in. thick. Floor beams are incased in concrete, so they too will serve as barriers. Intermediate ceiling barriers are also made of reinforced concrete cast with the floors. All switches are placed 7 ft. center to center, making barriers and conductors fall 28 in. apart. All main conductors run uniformly in the 7-in. switch cell spaces and there are no crossovers except through the buses.

The oil switches installed at this station are of the Westinghouse top-connected type, the disconnecting switches being mounted on the back of the wall. Connections were made so that bottom-connected switches could be installed, having one disconnecting switch mounted on the back of the wall and the other in a subcell compartment. The doors for the oil switch disconnecting switches are interlocked with the oil-switch operating mechanism, so that the doors cannot be opened unless the oil switch is open. The main switchboard, supplied by the Westinghouse company, is of the vertical panel type and is divided into generator feeders and auxiliary sections.

Direct current for oil-switch operation and emergency service is furnished by sixty storage cells of 200 amp. rating on a one-hour discharge basis. The cells were supplied by the Electric Storage Battery Company. For charging them a 25-kw. General Electric motor-generator set has been installed. In general, the General Electric Company provided the main and exciter generators, station service transformers, station service oil switches, transformer service and bus and station service switches. The generator, synchronizing and feeder oil switches, static dischargers, ground resistors and reactors were furnished by the Westinghouse Electric & Manufacturing Company. A General Electric automatic load-control system will be installed in the near future. Each main turbine is equipped with an unusually complete installation of indicating and recording instruments including Frahm vibration tachometers and Bristol recording instruments. The station is provided with a Richardson-Phenix oil filter and sightfeed indicators of the same make which are used on the water-cooling lines to the main and auxiliary turbine bearings. A Morgan crane and two Otis elevators are also installed in the plant.

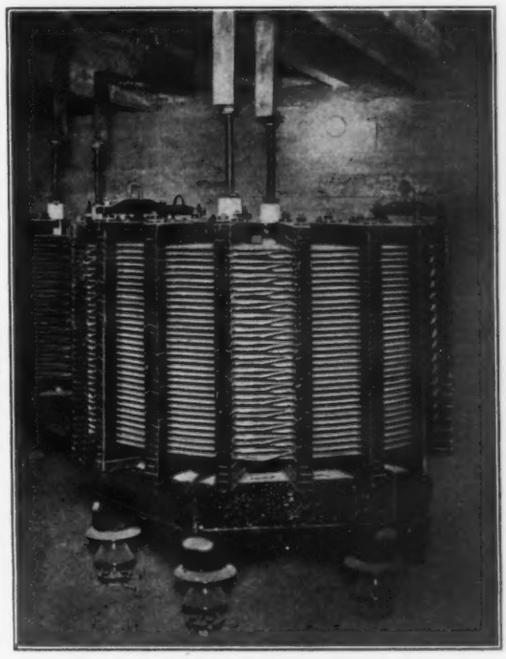


FIG. 8—METHOD OF MOUNTING SYNCHRONIZING AND GENERATOR REACTORS

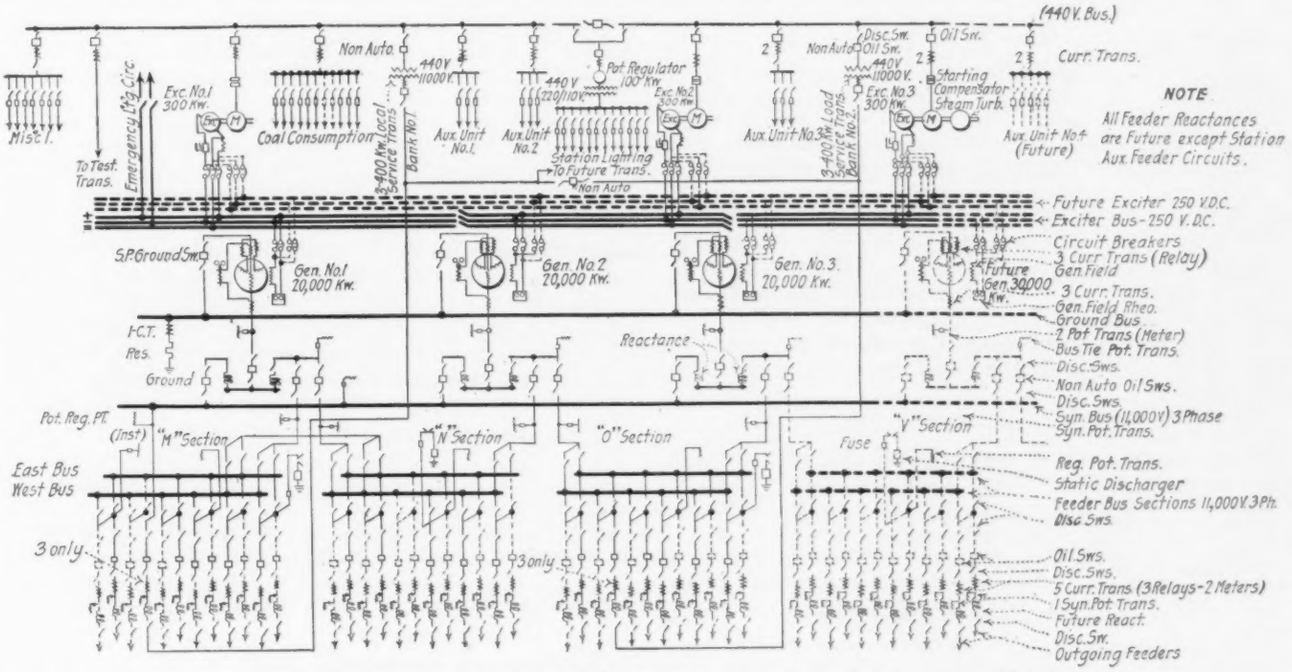


FIG. 7—CONNECTIONS BY WHICH ANY GENERATOR MAY BE JOINED WITH ANY FEEDER BUS

Insulation of High-Voltage Transformers

First of Two Articles Taking Up the Fundamental Principles Underlying All Problems of Insulation and Giving Data Which Will Enable the Determination of Insulation Dimensions for Different Services

BY ALFRED STILL
Professor of Electrical Design, Purdue University.

SERIOUS difficulties are not encountered in insulating machinery and apparatus for working pressures up to 10,000 or 12,000 volts, but for higher pressures (as in 150,000-volt transformers) designers must have a thorough understanding of the dielectric circuit,* otherwise insulation cannot be correctly and economically proportioned. In this article information has been assembled which should make the fundamental principles of insulation readily understood and should enable an engineer to determine in any specific design of transformer the thicknesses of insulation required in any particular position as between layers of windings, between high-tension and low-tension coils, and between high-tension coils and grounded metal. The data and principles outlined should also facilitate the determination of dimensions and spacings of high-tension terminals and bushings. In presenting this information two questions are considered: (1) What is the dielectric strength of the insulating materials used in transformer design? and (2) how can the electric stress or voltage gradient be predetermined at all points where it is liable to be excessive?

Apart from a few simple problems of insulation capable of a mathematical solution, the chief difficulty encountered in practice usually lies in determining the distribution of the dielectric flux, the concentration of

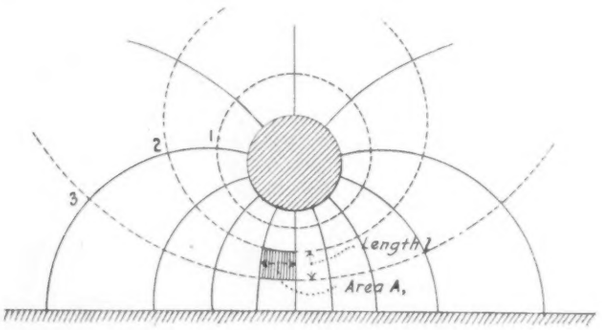


FIG. 1—DISTRIBUTION OF DIELECTRIC FLUX AND EQUIPOTENTIAL LINES BETWEEN ENERGIZED SPHERE AND FLAT PLATE

which at any particular point may so increase the flux density and the corresponding electric stress that disruption of the dielectric may occur. The conception of lines of dielectric flux, and the treatment of the dielectric circuit in the manner now familiar to all engineers in connection with the magnetic circuit has made it possible to treat insulation problems† in a comprehensive manner.

THE DIELECTRIC CIRCUIT

The analogy between dielectric and magnetic circuits may be illustrated by Fig. 1, where a metal sphere is supposed to be placed some distance away from a flat metal plate, the intervening space being occupied by air, oil or any insulating substance of constant specific capacity. This arrangement constitutes a condenser of which the capacity is (say) C farads. If a difference of potential of E volts is established between the sphere and, the plate, the total dielectric flux, ψ will have to satisfy the equation

$$\psi = EC \qquad (1)$$

where ψ is expressed in coulombs, E in volts and C in farads.

The quantity ψ coulombs of electricity should not be considered as a charge which has been carried from the sphere to the plate on the surface of which it remains, because the whole of the space occupied by the dielectric is actually in a state of strain, like a deflected spring, ready to give back the energy stored in it when the potential difference causing the deflection or displacement is removed. Instead, the dielectric should be considered as an electrically elastic material which will not break down or be ruptured until the "elastic limit" has been reached. The quantity ψ, which is called the dielectric flux, may be thought of as being made up of a definite number of unit tubes of induction, the direction of which in the various portions of the dielectric field is represented by the full lines in Fig. 1. The name of the unit tube of dielectric flux is the coulomb.

If the sphere were the north pole and the plate the south pole of a magnetic circuit, the distribution of flux lines would be similar. The total flux would then be denoted by the symbol Φ, and the unit tube of induction would be called the maxwell. In place of formula (1) the following well-known equation could then be written:

$$\Phi = Mmf \times \text{permeance} \qquad (2)$$

This expression is analogous to the fundamental equation for a dielectric circuit, the electrostatic capacity C being, in fact, a measure of the *permeance* of the dielectric circuit, while $\frac{1}{C}$ sometimes called the *elastance*, may be compared with reluctance in the magnetic circuit.

The dotted lines in Fig. 1 are sections through equipotential surfaces. The potential difference between any two neighboring surfaces, as drawn, is one-quarter of the total. At all points the lines of force, or unit tubes of induction, are perpendicular to the equipotential surfaces. Furthermore, the flux density, or coulombs per square centimeter, through any small portion A of an equipotential surface over which the distribution may be considered practically uniform is

$$D = \frac{\psi}{A} \qquad (3)$$

The capacity, or *permittance*,* of a small element of the dielectric circuit of length l and cross-section A is proportional to $\frac{A}{l}$, or with the proper constants inserted,

*The reciprocal of *elastance*.

* "Insulation and Design of Electrical Windings," by A. P. M. Fleming and R. Johnson—Longmans, Green & Co.
"Dielectric Phenomena in High-Voltage Engineering," by F. W. B. MacNutt—Macmillan Company.

†The dielectric circuit is well treated from this point of view in the following (among other) books:
"The Electric Circuit," by V. Karapetoff—McGraw-Hill Book Company, Inc.
"Electrical Engineering," by C. V. Christie—McGraw-Hill Book Company, Inc.
"Advanced Electricity and Magnetism," by W. S. Franklin and B. MacNutt-Macmillan Company.

$$\text{Electrostatic capacity} = C = \left(\frac{10^9}{4\pi(3\times10^{10})^2}\right)\frac{kA}{l} \text{ farads} \quad (4)$$

wherein the numerical multiplier results from the choice of units. Factor k is the specific inductive capacity, or dielectric constant, of the material ($k = 1$ in air), while the unit for l and A is the centimeter. This expression for capacity may conveniently be rewritten as

$$C_{mf} = \frac{8.84\,kA}{10^{8}\,l} \text{ microfarads} \quad (5)$$

Values of k are given in the accompanying table together with the dielectric strengths of the materials. These figures are only approximate, those referring to dielectric strength merely serving as a rough indication of what the material of average quality may be expected to withstand. The figures indicate the approximate virtual or r.m.s. value of the sinusoidal alternating voltage which, if applied between two large flat electrodes, would lead to the breakdown of a 1-cm. slab of insulating material placed between the electrodes.

What is generally understood by the *disruptive gradient*, or stress in kilovolts per centimeter, would be about $\sqrt{2}$ times the value given in the last column of the table. Thus, if a battery or continuous-current generator were used in the test, the pressure necessary to break down a 0.75-cm. film of air between two large flat parallel plates would be $1000 \times \sqrt{2} \times 22 \times 0.75 = 23{,}400$ volts.

DIELECTRIC CONSTANT AND DIELECTRIC STRENGTH OF INSULATORS

Material	Dielectric Constant, k	Dielectric Strength, Kv. per Cm.
Air	1	22
Transformer oil	2.3	..
Paper (dry)	2	80
Paper (oil impregnated)	3	100
Pressboard (dry or varnished)	3	125
Pressboard (oil impregnated)	5	150
Treated wood (across grain)	3 to 6	70
Porcelain	4.5	110
Varnished cambric	5	200
Mica	6 to 8	600
Micanite	5 to 7	300
Glass	4 to 10	90
Conductors	Infinity	..

Returning to formula (3), let *electric flux* or *quantity* of electricity, ψ, be expressed in terms of capacity and emf., with a view to determining the relation between flux density and electric stress. The formula (4) may be written

$$C = Kk\frac{A}{l} \text{ farads}$$

where K stands for the numerical constant. Substituting in equation (1) $\psi = E \times Kk\frac{A}{l}$

$$\text{whence } D = Kk \times \left(\frac{E}{l}\right)$$

Since E/l is the potential gradient, or volts drop per centimeter, which is sometimes referred to as the *electrostatic force* or *electrifying force*, and denoted by the symbol G, therefore

$$D = Kk \times G \quad (6)$$

The analogous expression for the magnetic circuit is, $B = \mu H$.

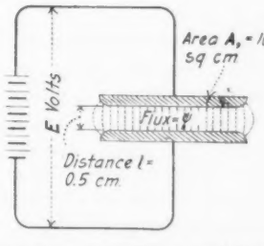


FIG. 2—ELECTRODES SEPARATED BY DIELECTRIC OF AIR

In the case of a dielectric circuit, *electric flux density = emf. per centimeter × "conductivity" of the material to dielectric flux*, while in the magnetic circuit *magnetic flux density = mmf. per centimeter × "conductivity" of the material to magnetic flux.*

Since the electric stress or voltage gradient G is directly proportional (in a given material) to the flux density D, it follows that when the concentration of the flux tubes is such as to produce a certain maximum density at any point breakdown of the insulation will occur at this point. Whether or not the rupture will extend entirely through the insulation will depend upon the value of the flux density (consequently the potential gradient) immediately beyond the limits of the local breakdown.

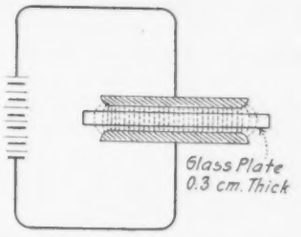


FIG. 3—ELECTRODES SEPARATED BY AIR AND GLASS

Given two electrical conductors of irregular shape, separated by insulating materials, the problem of calculating the capacity of the condenser so formed is very similar to that of calculating the permeance of the magnetic paths between two pieces of iron of very high permeability separated by materials of low permeability. There is no simple mathematical solution to such a problem, so the best that can be done is to fall back on the well-established law of maximum permeance, or "least resistance." According to this law the lines of force and equipotential surfaces will be so shaped and distributed that the *permittance*, or capacity, of the flux paths will be a maximum. With a little experience, ample time, and a great deal of patience the probable field distribution can generally be mapped out, even in the case of irregularly shaped surfaces, with sufficient accuracy to emphasize the weak points of the design and to permit determining the maximum voltage gradient approximately.‡

Before illustrating the application of the above principles to the design of transformer insulation, it will be advisable to assemble and define the quantities which are of interest to the engineer in making practical calculations.

Symbol:

E, e = emf. or potential difference (volts).

l = length, measured along line of force (centimeters).

A = area of equipotential surface perpendicular to lines of force (square centimeters).

$G = \frac{de}{dl}$ = potential gradient (volts per centimeter).

C = capacity or permittance (farads or microfarads) $\left(\text{farads} = \frac{\text{coulombs}}{\text{volts}} = \text{flux per unit emf.}\right)$.

K = constant = 8.84×10^{-14} (farads per centimeter cube, being the specific capacity of air).

k = dielectric constant, or relative specific capacity, or permittivity ($k = 1$ for air).

ψ = dielectric flux, or electrostatic induction ($\psi = CE = AD$ coulombs).

D = flux density = $\psi/A = KkG$ (coulombs per square centimeter).

CAPACITY OF PLATE CONDENSER

Imagine two parallel metal plates, as in Fig. 2, connected to the opposite terminals of a direct-current generator or battery. The area of each plate is A square centimeters and the separation between plates is l centimeters, the dielectric or material between the two surfaces being air. The edges of the plates should be rounded off to avoid concentration of flux lines. If the area A is large in comparison with the distance l, a uniform distribution of the flux ψ may be assumed in the air gap, the density being $D = \psi/A$.

‡This method of plotting flux lines is explained, in connection with the magnetic field, at some length in the writer's book, "Principles of Electrical Design"—McGraw-Hill Book Company, Inc., 1916.

By formula (5) the capacity is $C_{mf} = \frac{8.84 \times A}{10^5 \times l}$ microfarads, since the specific capacity of air k is 1. Assuming numerical values, let $A = 1000$ sq. cm., and $l = 0.5$ cm. Then, $C = \frac{8.84 \times 1000}{10^{14} \times 0.5} = 1.77 \times 10^{-10}$ farads.

If $E = 10{,}000$ volts, the potential gradient will be $G = \frac{10{,}000}{0.5} = 20{,}000$ volts per centimeter. There will be no disruptive discharge, however, because a gradient of 31,000 volts per centimeter is necessary to cause breakdown in air.

By formula (1) the total dielectric flux is $\psi = 10{,}000 \times 1.77 \times 10^{-10} = 1.77 \times 10^{-6}$ coulombs.

Charging Current with Alternating Voltage

The effect of an alternating emf., the crest value of which is 10,000 volts, would be to displace the above quantity of electricity $4f$ times per second, f being the frequency. The quantity of electricity can be expressed in terms of current and time thus, *quantity = current × time*, or *coulombs = average value of current (in amperes) during quarter period × time (in seconds) of one quarter period.* Therefore $\psi = I \times \left(\frac{2\sqrt{2}}{\pi}\right)\frac{1}{4f}$, where I stands for the virtual or r.m.s. value of the charging current on the sine wave assumption. Transposing terms, $I = \frac{4\pi f \psi}{2\sqrt{2}}$. If E is now supposed to stand for the virtual value of the alternating potential difference, $\psi = CE \times \sqrt{2}$, whence $I = 2\pi f CE$, which is the well-known formula for calculating capacity current on the assumption of sinusoidal wave shapes.

Capacities in Series

When condensers are connected in parallel on the same source of voltage, the total dielectric flux is evidently determined by summing up the fluxes as calculated or measured for the individual condensers. In other words, the total capacity is the sum of the individual capacities. With condensers in series, however, the total flux, or displacement, will be the same for all the capacities in series, therefore the calculations may be simplified just as for electric or magnetic circuits by adding the *reciprocals* of the conductance or permeance. The conception of *elastance*, corresponding to resistance in the electric circuit and reluctance in the magnetic circuit, thus has certain advantages. In the dielectric circuit *elastance = 1 ÷ [permittance (or capacity)] = 1/C.*

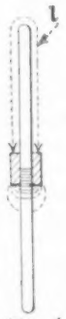


FIG. 4.

For a concrete example assume that a 0.3-cm. plate of glass is inserted between the electrodes of the condenser shown in Fig. 2. The modified arrangement is illustrated by Fig. 3. On first thought it might appear that this arrangement would improve the insulation, but care must always be taken when putting layers of insulating materials of different specific inductive capacity in series, as this example will illustrate. In addition to the elastance of a 0.3-cm. layer of glass there is the elastance of two layers of air of which the total thickness is 0.2 cm. Assuming that the value of the dielectric constant K for the particular quality of glass used is 7 and that G_g and G_a are the potential gradients in the glass and air respectively, then, by formula (6), $KG_a = 7KG_g$, whence $G_a = 7G_g$.

Taking the total potential difference between electrodes as 10,000 volts, the same as used in considering Fig. 2, $E = 10{,}000 = 0.2G_a + 0.3G_g$, whence $G_g = 5880$ volts per centimeter, and $G_a = 41{,}100$ volts per centimeter. Such a high gradient as 41,100 would break down the layers of air and would manifest itself by a bluish electrical discharge between the metal plates and the glass. On the other hand, the gradient of 5880 volts per centimeter would be far below the stress necessary to rupture the glass. Nevertheless a discharge across air spaces should always be avoided in practical designs because of its injurious effect on the metal surfaces and also on certain types of insulating material. It should be observed that the introduction of the glass plate has appreciably increased the capacity of the condenser. For example, with the same voltage ($E = 10{,}000$) as before, the total flux is now $\psi = AD = 1000\ (8.84 \times 10^{-14} \times 41{,}000) = 3.47 \times 10^{-6}$ coulombs. This value is nearly double the value calculated with only air between the condenser plates.

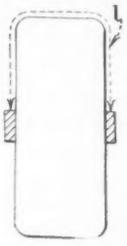


FIG. 5

As a practical application of the principles governing the behavior of condensers in series, consider the insulation between the coils and core of an air-cooled transformer, *i.e.*, of which the coils are *not* immersed in oil. In addition assume the insulation consists of layers of different materials made up as follows:

Material	Total Thickness — Mils	Total Thickness — Centimeters	Dielectric Constant (k)
Cotton brading and varnished cambric	70	0.178	5
Micanite	125	0.317	6
Pressboard	62	0.158	3
Air spaces (estimated)	24	0.061	1

Then suppose it is desired to determine how high an alternating voltage can be applied between the coils and the core before the maximum stress in the air spaces exceeds 31,000 volts per centimeter, the gradient which will cause disruption and static discharge, with the consequent danger to the insulation due to local heating and chemical action. Assuming the coil forms one flat plate of a condenser of which the other plate is the iron frame or core, it can be considered that the equivalent of a number of plate condensers in series is obtained, the total elastance being

$$1/C = 1/C_1 + 1/C_2 + 1/C_3 + 1/C_4$$

By formula (4), the individual capacities for the same surface area are proportional to k/l, therefore

$$KA/C = l_1/k_1 + l_2/k_2 + l_3/k_3 + l_4/k_4.$$

Since $\frac{KA}{C} = \frac{KAE}{\psi} = \frac{KE}{D} = \frac{KE}{KG_{air}} = \frac{E}{G_{air}}$, the permissible maximum value of E is,

$$E = 31{,}000\left(\frac{0.178}{5} + \frac{0.317}{6} + \frac{0.158}{3} + \frac{0.061}{1}\right)$$

$$= 6260 \text{ volts (maximum).}$$

The r.m.s. value of the corresponding sinusoidal alternating voltage is $6260/\sqrt{2} = 4430$, which is the limiting potential difference between windings and grounded metal work if the formation of corona is to be avoided. A transformer having insulation made up as previously described would be suitable for a 6600-volt three-phase circuit with grounded neutral, but for higher voltages the insulation should be modified or oil immersion should be employed to fill all air spaces. If the oil-cooled construction is employed, the previously-considered insulations (slightly modified in view of possible action of the oil upon the varnish) would probably be suitable for working voltages up to 15,000.

A large factor of safety must be allowed when determining the distance between electrodes measured over the surface of an insulator. Whether or not sparkover will occur depends not only upon the condition of

the surface (clean or dirty, dry or damp), but also upon the shape and position of the terminals or conductors. It is therefore almost impossible to determine, other than by actual test, what will happen in the case of any departure from standard practice. Surface leakage occurs under oil as well as in air, but generally speaking, the creepage distance under oil need be only about one-quarter that necessary in air.

An important point to consider in connection with surface leakage is illustrated by Figs. 4 and 5. In Fig. 4, a thin disk of porcelain (or other solid insulator) separates the two electrodes, while in Fig. 5, the same material is in the form of a thick block providing a leakage path (l) of exactly the same length as in Fig. 4. The voltage required to cause spark-over will be considerably greater for the block of Fig. 5 than for the disk of Fig. 4. This condition exists because the flux concentration due to the nearness of the terminals in Fig. 4 begins breaking down the layers of air around the edges of the electrodes at a much lower total potential difference than will be necessary in the case of the thicker block of Fig. 5. The effect of the incipient breakdown is, virtually, to make a conductor of the air around the edges of the metal electrodes, and a very slight increase in the pressure will often suffice to break down further layers of air and so result in a discharge over the edges of the insulating disk. The phenomenon of so-called surface leakage may thus be considered as largely one of flux concentration or potential gradient. Sometimes it will be easier to eliminate trouble due to surface leakage by altering the design of terminals and increasing the *thickness* of the insulation than by adding to the length of the creepage paths.

In a later issue of the ELECTRICAL WORLD will be published the second installment of this article which contains practical rules applicable to the insulation of high-voltage windings and a discussion of subjects dealing with the more practical side of insulation problems.

A Permeameter for Magnetic-Mechanical Testing

Construction and Operating Features of a Simple and Accurate Device for Measuring the Permeability and Hysteresis Constants of Steel

BY FRANK P. FAHY

ONE of the major difficulties which have hitherto attended systematic attempts to correlate the magnetic and mechanical properties of steels has been due to the lack of a suitably designed permeameter capable of making rapid and accurate measurements of single specimens over a large range of sizes. While it is true that comparatively rough magnetic measurements may at times be sufficient to permit of drawing conclusions as to physical condition, experience indicates that a higher order of accuracy than is usually reached, especially in regard to the hysteresis constants, is demanded for successful testing.

A great deal of attention has been given to the study of the magnetic characteristics which accompany changes in structure due to thermal and mechanical treatment of steels. It is, for instance, well known that a steel which is physically hard, as determined by the file, brinell or other hardness test, is generally magnetically "hard." Among many others, Guthe[1] and Maurer[2] have recorded the magnetic characteristics which accompany the various stages of temper in several grades of heat treated carbon steel. Goerens[3] has found the magnetic properties peculiarly sensitive to the degree of cold working in steels of widely-varying composition. Sanford[4] in a paper about to appear, describes results on material tested for homogeneity. Burrows[5] has reviewed the work already done in correlating magnetic and mechanical properties.

As the result of extended work along these lines, the writer has found that in a given material the magnetic characteristics may be used to indicate the mechanical characteristics. The value of a magnetic test lies in the fact that it offers a method of examining magnetic materials for certain characteristics which affect their mechanical performance, without in any way sacrificing their subsequent utility. Manufacturers of steel products are coming to realize the need of a stricter test control of their output, especially where heat treatment of expensive material is concerned, and interest in this method of test has been stimulated.

[1] *Trans., A. I. E. E.*, Vol. XIV, 1897.
[2] *Revue de Métallurgie, Mémoires*, 1908, Vol. V.
[3] *Jour. I. S. I., Memoirs*, Vol. III, 1911.
[4] *Bulletin of the Bureau of Standards*, Vol. XIV, 1916.
[5] *Bulletin of the Bureau of Standards*, Vol. XIII, 1916.

The instrument here described was developed in an endeavor to produce a permeameter of high accuracy devoid of complications and so adapted that it may be used either to compare the permeability of two specimens, one of which partakes of the character of a standard, or to measure permeability and the hysteresis constants for a single specimen. Fig. 1 shows the permeameter as designed for the measurement of bars, rods, and plate material. This same form has been used in the examination of tools such as drills and saws. The device has now been in use for some time and has given entire satisfaction in the sizes constructed.

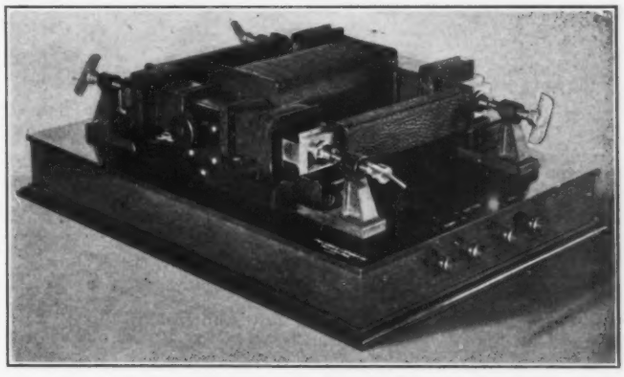


FIG. 1—PERMEAMETER FOR MAGNETIC-MECHANICAL TESTING

THE MAGNETIC CIRCUITS

In Fig. 2 is shown the permeameter in plan and elevation. B represents the base of the apparatus upon which is mounted a magnetic core of H-shape so fashioned as to form two symmetrical magnetic circuits, each of which includes the crossbar J in common. The remaining portions of one of these circuits embrace the core arms Y, Y and the air path between such arms; while the other includes the core arms Y', Y' and a similar air path. The crossbar J is divided midway between its ends into two sections separated by a small air gap, which may be closed to a greater or lesser extent by a screw piston, P, of magnetic material, actuated through the knurled head N.

The ends of the transverse core portions forming a part of each of the two parallel magnetic circuits are adapted for bridging by specimens of magnetic material. In Fig. 2 a standard specimen, *A*, the magnetic characteristics of which are known, bridges the core arms *Y*, and a test specimen, *X*, the magnetic characteristics of which are to be determined, bridges the core arms *Y'*. Clamps *O* serve to hold the specimens in place. The ends of the core arms *Y* and *Y'* are slotted to permit the insertion of bushings *W*, which vary in form according to the shape of the material bridging the core arms. The adjustable air gap in the crossbar *J* is designed to create a demagnetizing force within the core itself, which may be varied to suit requirements. When the gap is open to its fullest extent the magnetic poles created there, when the magnetizing current is broken in the act of reversing the current, are of material assistance in reducing the time constants of the magnetic circuits. This demagnetizing force may be adjusted to reduce to a negligible amount the magnetic field in the

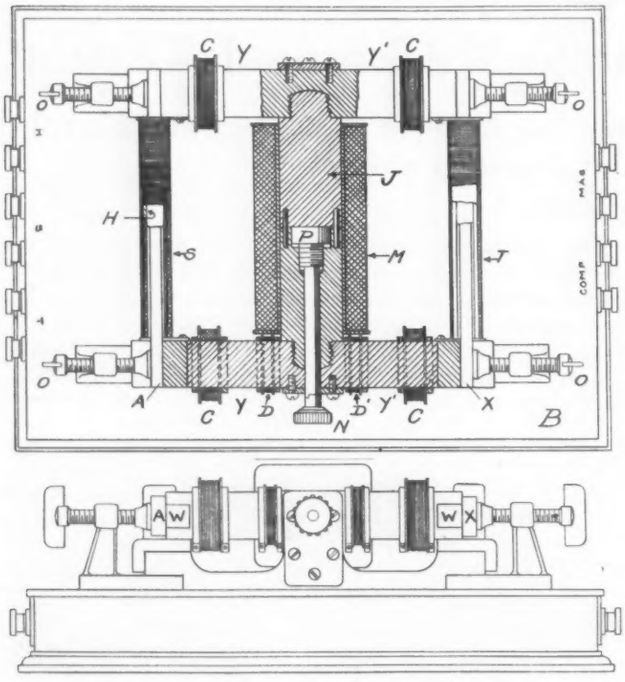


FIG. 2—PLAN AND ELEVATION OF PERMEAMETER

region occupied by the test specimen due to the residual properties of the core itself. Under this latter condition direct measurements of residual induction are simplified.

The magnetomotive force is applied in two sections—one over the crossbar *J* by means of current in the magnetizing coil *M*, and the other distributed in equal parts over the core arms *Y Y'* by means of current in the compensating coils *C*. The currents in these two sections are independently adjustable. The test coils indicated by *D*, *D'*, *S* and *T* are each of the same number of turns and placed as shown in the figure; *D* and *D'* on opposite arms of the same transverse core portion, and *S* and *T* uniformly wound on coil forms through which the standard and test specimens *A* and *X* respectively may be inserted. A test coil, *H*, of a relatively large number of turns is wound uniformly on the same form which carries the test coil *S*. The test coils *S* and *T* are of the same mean cross-sectional area.

Fig. 3 shows diagrammatically the flux paths within the magnetic core due to the magnetomotive forces generated by currents in the coils *M* and *C*. The magnetic field due to current in the magnetizing coil has the direction indicated by the arrows, or the reverse according to the direction of the current. The field due to current in the compensating coils has the direction indicated by the dotted line, its direction at any time depending upon the direction of the current in the compensating coils. It will be seen that when current is flowing in both magnetizing and compensating coils that one magnetic circuit has the magnetomotive force due to the magnetizing coil augmented by the current in the compensating coils, while the other magnetic circuit has its mmf. decreased by the same amount.

INTERNAL ELECTRICAL CONNECTIONS

Fig. 3 shows also the internal electrical connections of the permeameter. The magnetizing and compensating coils are connected to the binding posts marked "Mag" and "Comp" respectively. The test coils, *S*, *D*, *D'*, and *T* are permanently connected in series, taps being brought out to binding posts marked *S* and *T*. This series connection is carried out in such a manner that upon reversal of the current in the magnetizing coil *M*, the integrated emf. induced in the coils *S* and *D'* acts in the same direction and in opposition to the integrated emf. simultaneously induced in the coils *D* and *T*. Connection to the adjacent binding posts of the pairs marked *S* and *T* enables observation of the differential effect of the coils *D* and *D'* to be made. The permeameter is initially adjusted, so that this differential effect is zero when no specimens are in the apparatus.

The test coil *H* is connected to the binding posts marked *H*. This coil is used to determine the magnetic potential difference existing between its ends when it encircles air only, that is, when no specimen is inserted within it. The average magnetic potential drop per unit length of the winding *H* is equal to the average magnetizing force. The area turns of the coil are determined by measurements of the coil in a uniform field such as is produced by a long solenoid, and corrected empirically to allow for the difference between the length of the coil and the free length of the test specimen between contacts at the opposite pole faces.

A rugged D'Arsonval galvanometer, considerably overdamped, is employed as an indicating instrument. The galvanometer is calibrated by means of a mutual inductance of fixed value, the secondary of which remains permanently in the galvanometer circuit. A multiple point switch permits the galvanometer to be connected at will to the various test circuits.

The permeameter may be used for either relative or absolute measurements. That is, it may be used (a) to determine the normal induction of a specimen of unknown magnetic characteristics by comparing it with a standard or known specimen, or (b) to determine directly the normal induction and hysteresis of a specimen. The method of procedure depends to a considerable degree upon the accuracy desired. Where approximate values only are required the procedure is extremely simple.

A specially designed handle which engages the individual switches by means of latchets permits of the operation of the magnetizing and compensating switches either singly or in unison and also controls the insertion of resistances in determining hysteresis data.

1. *Approximate Determination of Normal Induction—By Comparison.*

The standard specimen *A*, the normal induction of which has been predetermined, is inserted in the coil *S* and the unknown specimen *X* in coil *T*. Both specimens are clamped in place. The magnetizing coil *M* is energized and the specimens demagnetized, if desired, by repeated reversals of a successively decreasing magnetizing current. The magnetizing current is then set at any desired value, subjecting both standard and test specimens to the effects of the same magnetomotive force, and the galvanometer deflection due to the reversal of

flux in the coil S, resulting from a reversal of current in M, is read. The galvanometer is then connected to the coil T and the deflection observed when the current in M is again reversed. The induction corresponding to the deflection due to the coil S, referred to the known data for specimen A indicates the magnetizing force to which both specimens are subjected. The deflection due to coil T indicates the induction in the specimen X. (Both observed inductions are, of course, subject to a correction due to the difference in area between the bars and the test coils.) Other points on the induction curve for X are obtained in a similar manner.

If it is desired to determine the induction in X without the necessity of inserting it within a coil, the galvanometer is connected so as to read the differential effect of the coils D and D'. The differential induction indicated, when algebraically added to the induction observed in coil S, gives the induction in specimen X.

2. *Accurate Determination of Normal Induction—By Comparison.*

The normal induction of a test specimen found in the foregoing manner is only approximately correct save when the standard and test specimens are of equal area and have similar permeabilities over the entire range of magnetizing forces. When these conditions do not obtain, errors of greater or less magnitude arise according to the degree of departure, because of the different magnetomotive force drops which exist in corresponding parts of the two parallel magnetic circuits and which result in dissimilar leakage characteristics. If the difference in the fluxes linking the test coils D' and T is less than the flux difference between D and S, a deflection of the galvanometer is observed when the latter is connected to S, D, D', and T in series and the current in M is reversed, which may be reduced to zero by means of current in the compensation coils C. These compensating coils are so energized that the magnetomotive force in the magnetic circuit which includes the test specimen is augmented over that due to the main solenoid alone, while the magnetomotive force in the circuit including the standard specimen is decreased. The magnitude of this compensating magnetomotive force is adjusted until, upon the simultaneous reversal of the magnetizing and compensating currents, the residual deflection of the galvanometer is zero. Then the leakage flux through the air path which is in parallel with the path of the coil T is equal to the leakage flux through the air path which is in parallel with the path of the coil S. Since these two leakage air paths are symmetrical and carry the same magnetic flux, the same difference of magnetic potential must exist between the ends of the path encircled by the coil T that exists between the ends of the path encircled by the coil S. This adjustment is to be made for each point on the normal induction curve. In measuring the induction of A and X the currents in M and C are reversed simultaneously.

3. *Absolute Determination of Normal Induction*

Absolute measurements of normal induction are made without the use of a standard bar, which must be removed from the permeameter. Compensation for unequal magnetomotive force drops in the two magnetic circuits should be made as in 2, except when approximate results only are desired. The measurement of the magnetizing force and induction are made while reversing simultaneously the currents in M and C. The deflection of the galvanometer, when it is connected to H, gives directly the magnetizing force acting on the specimen X. For the coil H which is wound uniformly along the length of the coil S, may be used to measure the difference in magnetic potential and hence of the mean magnetizing force for this region, which is also the mean magnetizing force along the path of the coil T within which the test specimen lies. The induction of the specimen X is read when the galvanometer is connected to T as before.

4. *Absolute Determination of Hysteresis Data*

Measurement of hysteresis data for a specimen is made without the use of a standard bar, the magnetizing force being read from coil H and the induction from coil T as in 3. For the sake of brevity, the determination of residual induction and coercive force only will be described.

Residual Induction.—Compensation is effected for the maximum induction desired. The current in coil M is reduced to zero, and the compensating current varied at the same time so that, the galvanometer being connected to S, D, D' and T in series, the residual deflection is zero. Returning to the condition of maximum induction the deflection due to these current changes is observed when the galvanometer is connected first to H and then to T. If the gap adjustment is correct the true magnetizing force will be zero when the

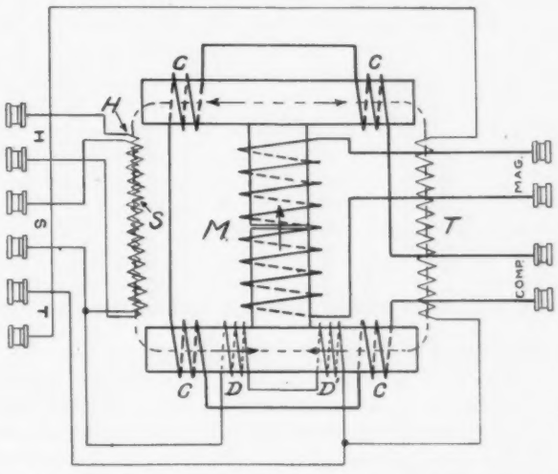


FIG. 3—FLUX PATHS AND ELECTRICAL CONNECTIONS

current in M is reduced to zero. The change in induction is indicated by the deflection due to T. It is not essential that the gap adjustment be correct, since a positive or negative magnetizing force, as required, can be applied by means of current in M so that the true magnetizing force is zero.

Coercive Force.—Compensation is effected for the maximum induction desired as before. The current in coil M is reversed and at the same time reduced in value, the compensating current being varied as required simultaneously so that the galvanometer deflection due to coil T indicates a true induction equal to zero. These adjustments are to be made under such circumstances that the residual deflection due to coils, S, D, D' and T is zero as when obtaining residual induction. The deflection due to the coil H, upon reducing to zero the magnetizing and compensating currents required to produce zero induction in the test specimen, indicates the coercive force.

The permeameter described has been designed for magnetic-mechanical testing and meets the requirements of accuracy, simplicity, and ease of manipulation which such work demands. The special switching devices employed and the use of an overdamped galvanometer so arranged as to permit of removal of the damping at will permits of considerable rapidity in adjusting compensation and the taking of observations. In many cases the degree of accuracy desired may not call for compensation, but even where accuracy is required the operations are sufficiently simple as to demand little previous experience on the part of the user.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SPECIAL ARRANGEMENTS TO WORK ON LIVE LINE

Voltage-Changing Scheme Used by California Company to Remodel 11,000-Volt Line Near Sea Shore While Alive

BY L. M. KLAUBER

Superintendent Electric Department, San Diego Consolidated Gas and Electric Company

The San Diego (Cal.) Consolidated Gas & Electric Company recently found it necessary to rebuild a 3.5-mile section of its 11,000-volt distribution lines in order to provide for a future increase in voltage to 22,000.

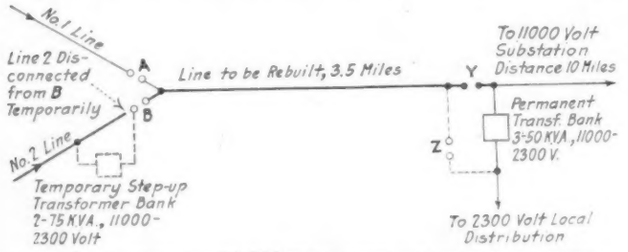

No. 1 Line
Line 2 Disconnected from B Temporarily
A
B
Line to be Rebuilt, 3.5 Miles
Y
To 11000 Volt Substation Distance 10 Miles
Permanent Transf. Bank 3-50 KVA, 11000-2300 V.
Z
No. 2 Line
Temporary Step-up Transformer Bank 2-75 KVA., 11000-2300 Volt
To 2300 Volt Local Distribution

FIG. 1—LAYOUT OF 11,000-VOLT LINE THAT WAS CHANGED

In this particular section a duplicate tie line was not available, and it was necessary to maintain service in the 10-mile section beyond the part to be remodeled. It was not possible to effect the extensive changes desired with the line "alive," since it is close to the sea shore, with poles and crossarms damp, and insulators covered with salt dust.

The load beyond the section to be rebuilt did not exceed 100 kw. in the daytime; however, it was approximately 300 kw. at night. It was therefore decided to lower the voltage of the line section worked on during the daytime to 2300 volts and raise it to 11,000 at night to take care of the peak load. The arrangement of the lines is shown in Fig. 1. At the end of the line toward the generating station two lines tie into the section worked on, as shown in the sketch.

To carry out the scheme mentioned, two 75-kva., 11,000 to 2300-volt transformers were mounted on a horse-drawn truck and placed under the pole containing switch *B*, as indicated in Fig. 1. For safety the transformers were fenced in, as shown in Figs. 2 and 3. Line 2 was then disconnected from switch *B* and was connected instead to the primary of the temporary transformer bank.

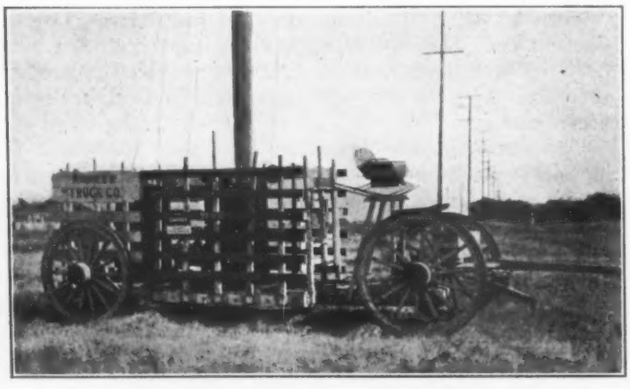


FIG. 2—PORTABLE TRANSFORMERS USED FOR CHANGING VOLTAGES FROM 11,000 TO 2300

At the outer end of the section there was available a small permanent step-down station of 150-kva. rating, furnishing three-phase energy at 2300 volts to a suburban town. It was decided to use this station as a step-up bank in the daytime, and for this purpose a temporary switch *Z* was connected in the circuit as shown. In the morning switches were operated as follows: Open *A*, open *Y*; close *B*, close *Z*. At night the order was open *B* and *Z*; close *A* and *Y*. Telephones were available at each point, and during the two weeks the rebuilding was in progress the line was changed over each night and morning without accident and with only momentary shutdowns.

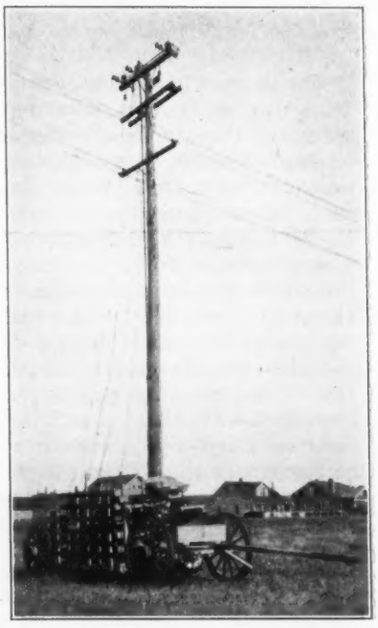


FIG. 3—PORTABLE TRANSFORMERS CONNECTED TO LINE AS SHOWN AT B IN FIG. 1

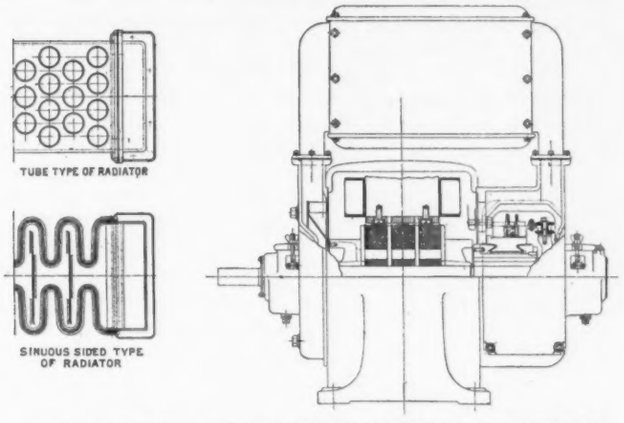
The work of remodeling done on the line included changing two of the conductors from No. 6 to No. 4 (the other being already of the larger size), and installing new crossarms, insulators and pins. The old crossarms were first lowered and temporarily fastened to the poles about 6 ft. below the top. The two wires to be changed were then attached to the old crossarms and the new crossarms mounted in position and the new wires pulled in. The work was further complicated by the cutting out of six transpositions which were in the line as originally built.

Methods for Inclosing Motors for Explosive or Moist Surroundings

Of the many expedients that have been employed to totally inclose electric motors, the one shown in the accompanying illustration, as described in a recent issue of the London *Electrical Review*, seems to possess points of interest. The purpose of the construction shown lies in a practical means of providing large radiating or air-cooling surfaces in such a manner that the system can be applied to standard machines. The construction is such that the surface can easily be adjusted by the manufacturer to suit any requirement.

The cooling surfaces are made in various forms, illustrations of two of which are shown here. In the first

of these the radiator proper consists of a box with end pieces designed to join with vertical openings in the motor end covers. Through this box pass in a vertical direction a number of thin metal tubes. Inside the back bearing of the motor a fan is fitted on the armature shaft which causes a circulation of air through the machine and through the radiating box. The arrangement



TUBE AND CURVED SIDED TYPES OF RADIATORS FOR TOTALLY INCLOSED ELECTRIC MOTORS

of the tubes, etc., is such that the air impinging on the thin vertical tubes brings about a large cooling effect. The advantages claimed for the system are that increased radiating surface is not only provided, but that as the tubes are thin compared with the motor frame the radiation is much greater, and that it is hence possible to approach within quite reasonable limits, the capacity of a ventilated motor of given frame size without the use of excessive radiator dimensions.

Another possible form of this invention is also shown in the illustration. In this case the tube radiator is replaced by one having thin sinuous metal sides with top and bottom covers, and also having mounted inside radiator baffle plates which cause the air to impinge in a thin stream against the outside surfaces, so that this type performs the same functions as the tube radiator. It is said that this type of motor is especially suited for use in either an explosive, dust laden or wet atmosphere.

Welding Outfit Saves Expense in Manhole Repairs

The oxyacetylene welding outfit shown in the accompanying illustration is employed by the Commonwealth Edison Company of Chicago in making repairs on manhole covers and on manhole frames. The usual repair required on a manhole frame consists of building up worn down flanges and edges. Sometimes, however, a cracked frame is repaired. In either case the building up or the welding is done without removing the frame. When a manhole cover is broken a new one is taken out and put in its place. The broken one is brought into the shop and repaired there with this apparatus. This course is pursued because it is necessary to preheat the heavy cover over an open fire to prevent it from cracking during the welding operation.

FIG. 1—OPERATOR AT WORK BUILDING UP A WORN MANHOLE FLANGE

This welding outfit has been in use since last August, and none of the covers repaired has failed when put back into service. Badly worn flanges which were built up have caused no further complaint. A conservative estimate of the saving effected by using this process in repairing is placed at $20 per frame. This saving is made possible on this work because with other methods the frames must be taken up, and the expense of tearing up and replacing pavement adds to the cost. By using this method of repairing covers it has been possible to effect a saving of $2 per cover.

Air in Water Causes Pipe Corrosion

BY H. A. HOLMES
Consulting Engineer, Pensacola, Fla.

Recently the writer was called upon to discover the cause of pipe corrosion which appeared to be due to electrolysis. In Fig. 1 is shown the location of the building and its proximity to a street car line and bay. One of the first things noted on starting the investigation was that the corrosion shown in those pipes which had been removed was greatest on one side of the hot water pipes which had come from horizontal runs. This side was afterwards shown to be the top. To satisfy the authorities voltage readings were taken along the pipes.

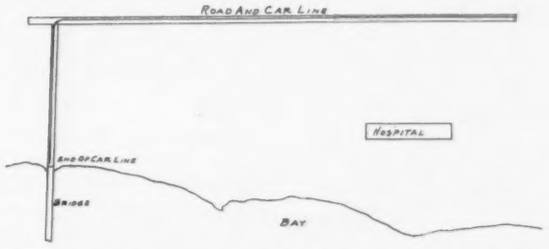


FIG. 1—LOCATION OF BUILDING WHERE PIPE CORROSION WAS OBSERVED

The maximum reading obtainable was over a stretch of about 100 ft. and amounted to slightly over 1 millivolt. This potential was ascribed to galvanic or thermo-electric action between the zinc on the pipes and the copper leads, because of the fact that the voltage did not change appreciably with the length of the pipe included between the leads. To refute galvanic action, rods of zinc, copper, brass, iron and platinum were placed in a glass where hot water could run on them. Potential readings were taken with the following results:

EMF. BETWEEN METALS IN HOT WATER

	Zn	Cu	Fe	Brass	Pt.
Pt.	0.6	0.17	0.38	0.03	0
Brass	0.55	0.10	0.35	0	
Fe	0.3	0.12	0		
Cu	0.25	0			
Zn	0				

These potentials disappeared when metals were placed in contact, hence they could not be responsible for the corrosion.

A similar test was made with metal rods in hot water allowed to stand which gave voltage readings between metals as follows:

	Zn	Fe	Brass
Brass	0.15	0.1	0
Fe	0.15	0	
Zn	0		

This would indicate that the material which had been

so active had almost disappeared. A test made with cold water showed almost similar results.

With this data in hand, the writer was able to approach the authorities and prove to them that the entire cause of the trouble was the air which was contained in the water in large quantities. This was easily noticed in drawing a glass full of water from the faucet.

Scheme for Thawing Ice from Crane Trolley Wires

BY J. H. EDWARDS

Several times each winter considerable trouble has been experienced at the shops of the Chicago, Rock Island & Pacific Railroad at Silvis, Ill., due to the accumulation of ice and sleet on the trolley wires of outdoor traveling cranes. Scrapers and sleet-cutting wheels have proved impractical, due to the type of the collector system used. It was therefore decided to install a resistance permanently on the trolley line for thawing the ice by electricity.

The first 220-volt line so equipped consists of two No. 2/0 bare copper wires each 1200 ft. long hung on brackets from 30-ft. poles and serving several gantry cranes. A 0.312-ohm, 500-amp. grid resistance was mounted in a weatherproof box about 4 ft. from the ground on a pole at the opposite end from the main feeders. This resistance was connected through a switch so it could be thrown directly across the end of the No. 2/0 trolley line. The resistance of the line (0.19 ohm) plus that of the grid resistance is sufficient to limit the current to about approximately 440 amp., thus heating the trolley wire.

This device was used for the first time on an accumulation of sleet about 5/16 in. thick. In ten minutes after the switches were closed all traces of sleet had disappeared from the trolley wires. The actual power cost in this case was less than 40 cents.

High Potential and Ground Tests on Commercial Circuits

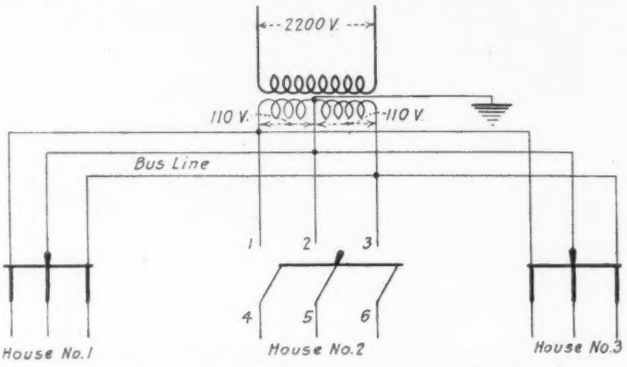
The use of a voltmeter and an instrument potential transformer to detect high-voltage grounds on customers' 110-volt circuits has been found to give good results when carried out in the following manner. It is advisable for the tester to first make a test for high voltage on the circuit before testing for grounds. The instrument transformer should be used in this test, with the service switch left closed and readings taken from each wire to ground. Zero readings indicate the circuit clear of high voltage, while any deflection of the pointer will indicate high voltage. In this case each house on the circuit should be cleared by opening the service switch and the line department called to locate the fault.

VOLTMETER READINGS UNDER CLEAR AND GROUND CONDITIONS WHEN TESTING HOUSE CIRCUITS AT POINTS IN ACCOMPANYING SKETCH

	Volts	
1, 2, 3 to ground	110-0-110	Incoming line clear
1, 2, 3 to ground	0-110-220	No. 1 grounded outside of house
Tests on House Wiring		
1 to 4, 1 to 5 1 to 6, 3 to 4 3 to 5, 3 to 6	All zero	Clear

If not zero, the line on which the reading is obtained is grounded.

In testing for a ground, all lamps should be turned off, the line switch opened and readings taken from wires 1, 2 and 3 to ground. If the readings are 110-0-110 respectively, the incoming line is clear. The house wires should then be tested with the switch still open. If there is no deflection when readings are taken between the points 1-4, 1-5, 1-6, 3-4, 3-5 and 3-6, shown in the sketch, the house circuit is also clear. If there is a deflection of the voltmeter on any of these tests, the line on which the reading is obtained is grounded. However, if when testing from 1, 2 and 3 to ground the readings 0, 110 and 220 are obtained, the test indicates that the neutral is not grounded, but that there is a ground on an outside wire. The tester must then go to



CIRCUITS TO WHICH REFERENCE IS MADE IN GROUND TESTS

the transformer to ascertain if the wrong wire has been grounded. If the line wiring is correct the tester must go to every house on the circuit until the house with the ground is found.

Advantages in Bonding Underground Cable Sheaths

The bonding of the lead sheaths of underground cables is a matter affecting the life of the sheaths, the continuity of service and the cost of maintenance in most large underground distributing and transmission systems. Bonding the sheaths tends to prevent electrolysis of the lead, or at any rate delays the rate at which it occurs, is often the means of preventing costly if not disastrous manhole fires, and more or less prevents the intense heat from an arc from spreading over an extensive area. Bonding is obviously therefore an important factor in striving for continuity of service, low cost of upkeep and long life of underground cables. Bonding of sheaths is relatively more important the larger the underground conducting system, because the larger the system the greater the current carrying capacity of the cables; the greater the capacity behind a short-circuit, the more congested are the manholes and the more extensive the damage in any case tends to be. Bonding the individual sheaths of all cables and connecting them together in each and every manhole and grounding tends to prevent electrolysis by offering a more direct path to ground, and one of lower resistance. to stray or foreign current, than from the sheath through the damp ducts and soil to earth.

Not the least value of bonding is that it reduces to a minimum the likelihood of manhole fires, and tends to make a disturbance due to an arc or short-circuit of as short duration as possible. In large cities where the underground system has grown, the size of the cables and the station capacity behind them has likewise increased. Each cable has large current carrying capacity, with almost unlimited capacity behind it for an appreciable period of time under short-circuit conditions. When a sheath is bonded to earth and a short-circuit occurs between the conductor and the sheath the current rush is in all probability of sufficient magnitude to operate the current interrupting devices at both ends of the defective line. On the other hand where the sheath is not grounded an arc once started may

persist for a considerable length of time without making itself visible on the station meters. With the unbonded sheath, and favorable resistance of conductor, the resistance of the two serves to act as a stabilizing resistance for the arc, which plays on adjacent cables and causes extensive damage. With unbonded sheaths this has often happened, the indication that something was wrong only making itself evident through the breakdown of some cable under the influence of the arc from the cable originally in trouble.

Unbonded sheaths are probably the most prolific cause of manhole fires. The insulating materials used in underground cables are inflammable, once they become ignited, and once such a fire starts it burns vehemently, causing havoc, costly damage and serious interruptions.

In some instances manhole fires, of course, start from short-circuits of alternating or direct current cables. High voltage, high capacity cables usually break down and either open the circuit breakers at the station without opening the cable sheath or else the cable explodes. In either instance the arc usually goes out before much damage is done. With the lower alternating-current voltages, 2200 to 6000 volts, the cable may explode or the conductors burn off completely before the station supply is interrupted. It is the large direct current feeders, at voltages of 250 and 600 volts which are the ones from which the most extensive arcs, and the ones lasting the longest, are to be expected. The remedy is to do the bonding so thoroughly that the resistance of the return path of the short-circuit current is low enough to permit sufficient current to flow to operate the overload tripping devices at the station or stations.

Control Schemes for Print-Shop Motors

Several methods of mounting and controlling motors for print-shop applications in the plant of the David Press, Worcester, Mass., are shown in the accompanying illustrations. In Fig. 2 a 0.5-hp. motor is connected to a 12-in. by 18-in. Golding job press through a friction pulley. Power is applied to or cut off from the motor terminals by a push-button switch attached to the under side of the press shelf. Speed control is permitted by a pedal at the right of the machine, which shifts the motor brushes through the medium of levers and connecting linkwork. The motor has a speed range of about three to one, easy gradations being permitted by the operator varying the pressure on the pedal.

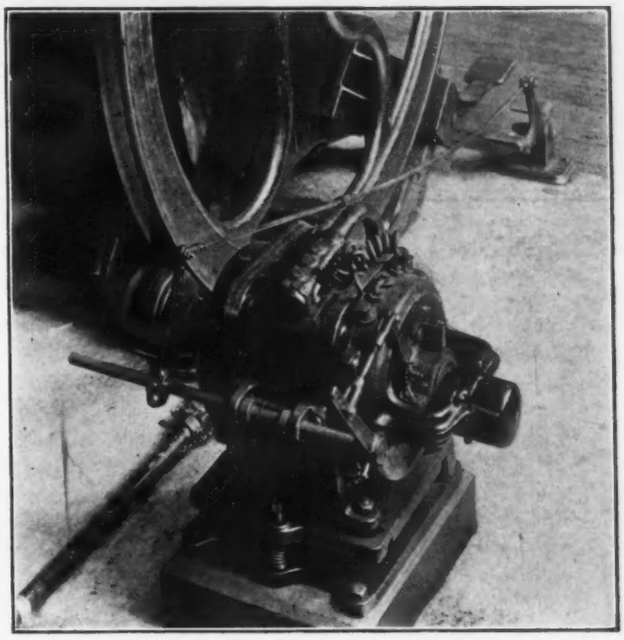


FIG. 2—GOLDING PRESS DRIVEN BY MOTOR WITH BRUSH-SHIFTING ATTACHMENT

Rheostat control and an automatically operated main switch are provided for the 1.5-hp. motor driving the 13-in. by 19-in. Standard automatic press shown in Fig. 1. A flywheel is installed in addition to the pulley to absorb peak loads and thereby regulate the speed. The main switch which may be seen in the foreground between the rheostat and flywheel, is connected with the main operating lever of the press by a link so that it will be opened and closed simultaneously with the operation of this lever. All wiring to the main switches as well as the branch circuits to the rheostat and motor are inclosed in conduit with condulet terminals.

Two monotype machines are in use in the plant, each being equipped with a 0.5-hp. motor having an adjustable set of resistance disks at one end of the shaft by which the speed can be varied from bare turn over to normal. This control equipment was furnished with the motor by the Kimble Electric Company, the makers of all the variable-speed and some of the constant-speed motors in the plant. Most of the motors are single-phase units designed for variable-speed operation.

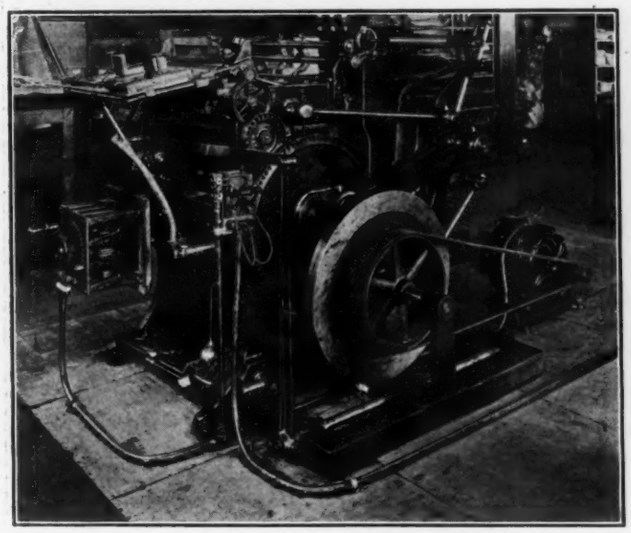


FIG. 1—STANDARD AUTOMATIC PRESS WITH SPECIAL CONTROL ARRANGEMENTS

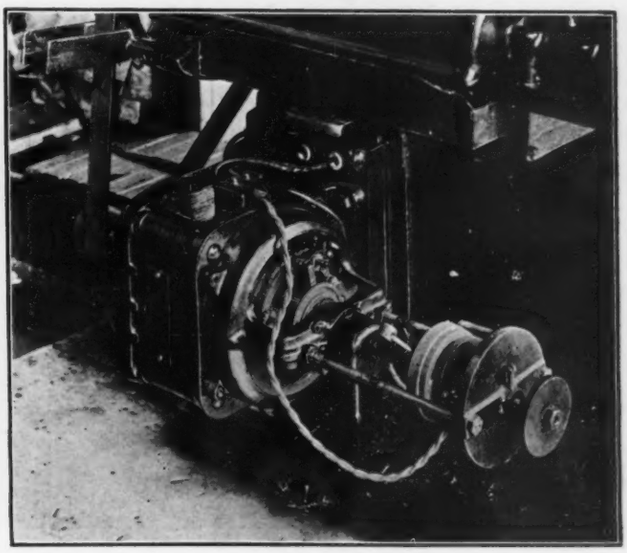


FIG. 3—VARIABLE-SPEED MOTOR INSTALLATION FOR A MONOTYPE MACHINE

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

CO-OPERATING WITH THE BUILDER IN WASHINGTON

The New "All-Electric" Arlington Apartment Building, One of Several Structures to Be Electrically Equipped Throughout

BY G. P. MANGAN

District Manager Potomac Electric Power Company

"Do it electrically" is the pass-word—both upstairs and down—in the new Arlington Hotel Apartments in Washington, D. C., where complete electrical appointments have been the outcome of systematic co-operation between the central station and the builder and owner, J. J. Moebs.

The suites in this building were designed to meet the needs of those whose living arrangements do not require housekeeping quarters, but who may wish to prepare food in their apartments on special occasions. Some of the suites have kitchenettes which contain small electric ranges; also cold storage vaults and ice-water faucets, both of which are supplied from an electric refrigeration plant. The other suites have serving stands, each of which is equipped with an electric coffee percolator and an electric grill.

All suites have electric grates in the fireplaces. These grates are of black iron, into which is fitted a specially designed frame work which is covered with broken glass. Under the frame work is a red electric lamp, giving a very cheerful and homey effect.

Any tenant in this very modern building may 'phone to the office on the first floor and secure the use of an electric vacuum cleaner or an electric iron, a generous supply of both being always on hand. The owner has also provided electric clothes washing machines and an electric mangle for the use of the tenants.

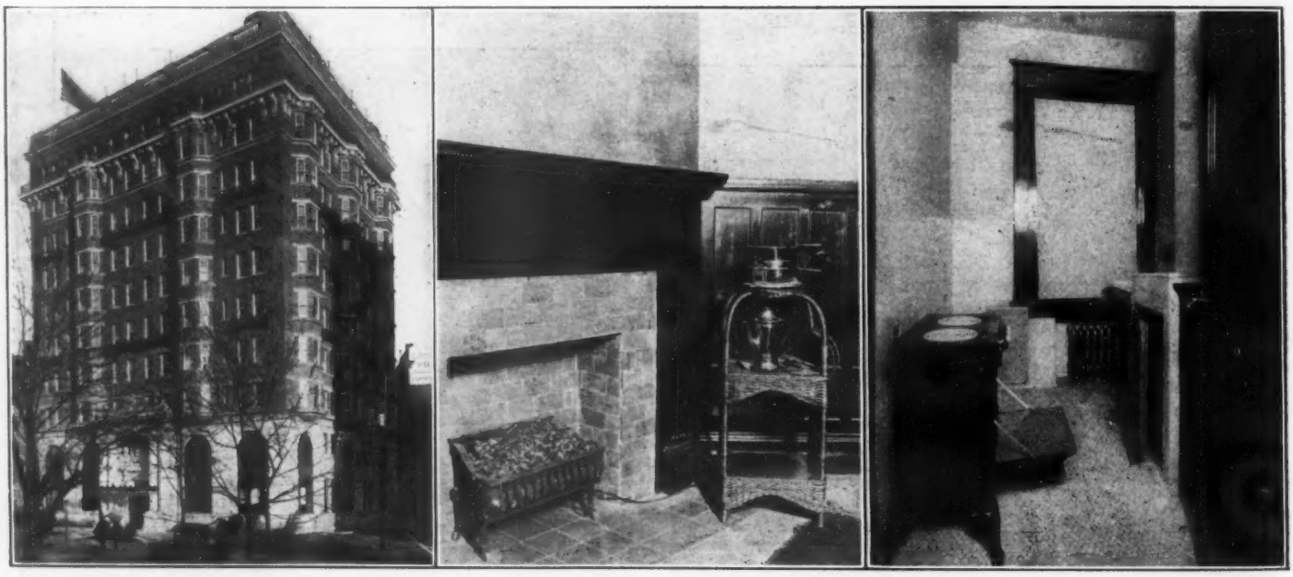
An electric dish-washing machine is used in the public café, and the ice cream served there is prepared in an electric freezer connected to the electric refrigeration plant. In the café, welsh rarebits, "ringtumdidee" and savory oyster stews are prepared in electric chafing dishes. An electric floor polisher maintains a dancing glaze under foot.

Of course the building is electrically lighted throughout, and the two elevators are both electrically operated.

Obviously, the owner is thoroughly converted to the electric way of doing things. It happens, however, that to a great extent, the installation is a "repeat order." Several of Mr. Moebs' buildings have had electric lights, electric elevators, and electric refrigeration plants in operation for a number of years. About eighteen months ago he completed a building in which he installed electric ranges in all of the housekeeping apartments in the building. These ranges have been in regular operation and besides cooking very satisfactorily and at an economical cost, they have occasioned very little expense for upkeep.

This same builder is now erecting a building which will have large housekeeping apartments. Each apartment will have an electric range and an electric fire place and the building will provide electric refrigeration, vacuum cleaners, electric irons, electric washing machines, mangle and other electrical conveniences such as are available in the Arlington apartments. In addition there will be a garage in the basement equipped with the requisite outfits for charging electric batteries.

These facts indicate clearly the advantages to be gained by a central station company by closely co-operating with the progressive building operators in their localities. Washington is not a manufacturing city. Being unable to secure much large power business, we naturally turn to the classes of business that can be developed, and domestic applications of electricity open a wide field for our efforts. The building operator is deserving of our best attention and we do everything we can to render him every service that lies in our



THE NEW ARLINGTON APARTMENT BUILDING, WASHINGTON, D. C., AND VIEWS OF A TYPICAL ELECTRIC KITCHEN AND ELECTRIC FIREPLACE IN ONE OF THE LIVING ROOMS

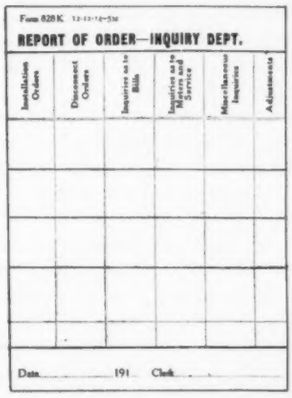
power. Of course, we take advantage of every opportunity to suggest new ways in which electricity can further popularize his buildings, but we are careful to avoid freak ideas and to suggest something that will stick—something that will produce "repeat orders."

A CUSTOMER POLICY THAT BRINGS FRIENDS AND BUSINESS

Practices of a Successful Central Station with Respect to Sales Organization, New Contracts, Prompt-Payment Discounts, and Service Disconnections

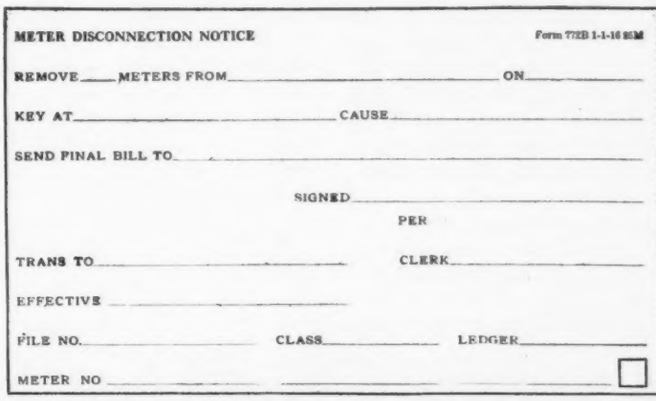
In a certain American city the local electric lighting company is the favorite utility of the public. It is not uncommon, for example, to hear householders remark: "If the telephone company and the gas company would only do the same as the electric light company does!" Such comments serve to illustrate the friendly regard in which the company is held, but back of such sentiment of course, stands the definite customer policy which has been wrought by far-seeing executives. It is the purpose of the following paragraphs to tell of some of the practices of this company's sales department in dealing with the public, because it is believed that these methods are in a good share responsible for the friendly sentiment.

Without offering prospective patrons any special inducements this company last year secured business


Form 828K
REPORT OF ORDER—INQUIRY DEPT.

Installation Orders	Disconnect Orders	Inquiries as to Bills	Inquiries as to Meters and Service	Miscellaneous Inquiries	Adjustments

Date ..... 191 .. Clerk .....


METER DISCONNECTION NOTICE Form 772EB 1-1-16 SSM

REMOVE ____ METERS FROM _____ ON _____

KEY AT _____ CAUSE _____

SEND FINAL BILL TO _____

SIGNED _____

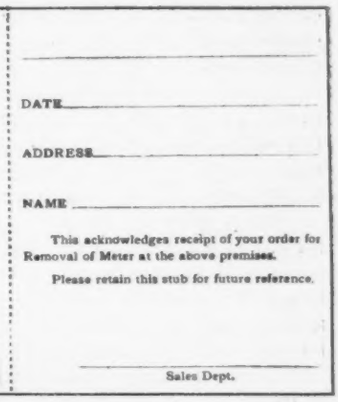
PER

TRANS TO _____ CLERK _____

EFFECTIVE _____

FILE NO. _____ CLASS _____ LEDGER _____

METER NO _____


DATE _____

ADDRESS _____

NAME _____

This acknowledges receipt of your order for Removal of Meter at the above premises.

Please retain this stub for future reference.

Sales Dept.

FIG. 1—SERVICE MUST BE RENDERED TO RESIDENCE CUSTOMERS WITHIN TWENTY-FOUR HOURS OF SIGNING CONTRACTS. FIG. 2—METERS ORDERED DISCONNECTED ARE NEVER REMOVED IN THE AFTERNOON LEST HOUSEHOLDERS BE BY MISTAKE DEPRIVED OF SERVICE SO LATE THAT IT COULD NOT BE RESTORED BEFORE DARK

from owners of nearly 5000 already-built houses. The figure is typical of the company's records for recent years, yet this central station does not and never has conducted special house-wiring campaigns. In the city referred to people seem to wire new houses just as they pipe them for water. In fact, it has been said repeatedly that every house in this community costing more than $1,500 is without exception wired for electric service when it is built; none of them uses combination gas and electric fixtures.

If the question is asked of the company's sales department, "How do you get the residential electric service business?" the answer given is, "We handle the residential business as a matter of routine. It is a year-round affair with us. For a long time we have been offering attractive residence rates. Our average residence rate is 5.6 cents per kilowatt-hour, and the average annual return from residence customers last year was $19.50. We have assured our patrons good service by always anticipating increases in load and providing power-house and line equipment to meet the demands. Now we are installing about 1000 services a month."

The sales department consists, besides the sales manager, of ten commercial lighting salesmen, seven power salesmen, one residence lighting salesmen, a force of counter clerks who are also salesmen, and the usual group of clerical aids. This sales department handles all of the company's dealings with the public. Each of the ten lighting salesmen is assigned a district, but the seven power salesmen have no particular districts. Their work is assigned on the more important power prospects according to their ability and experience. Each is provided with an automobile so that he can cover a large territory. The business handled is divided by classes and not by its geographical location.

In order to avoid duplication of effort and conflict, it has been ruled that prospective small power business belongs to the salesman who first discovers it and claims it by filing a card in the office of the sales manager to signify that negotiations have been opened. These methods of allotting business, it is thought, make each salesman continually alert in his search for new business. Every man searches every source for "leads."

The salesmen are also charged with the duty of retaining business after it has been secured. The detailed work of securing data on isolated plant installations and other prospective power customers is lifted from the shoulders of the power salesmen by a testing division. The salesmen sometimes assist in this work when their special knowledge is required.

The counter salesmen are quite often selected for their positions with the fact in view that they will later be promoted to the commercial lighting or power-sales divisions. They must be courteous and be of the salesman type, for, surprising as it may seem, they handle 95 per cent of the contracts taken by the company. In one month of 1915 these counter salesmen waited on 18,000 people.

Of the 4563 contracts taken in a typical month 1060 required services to be run. In only 214 instances meters were installed before contracts were signed, and 319 meters had been in service where the account was merely transferred to a tenant's successor. Five per cent of these contracts were taken by salesmen and the balance were signed in the office. That is the reason the company needs but one residence lighting salesman.

The commercial lighting and power salesmen are charged with the duty of calling upon customers after contracts have been signed at the office and seeing whether some other type of contract would be more profitable to the customer. Theirs is the duty of keeping customers satisfied. These salesmen formerly asked prospective customers not to go to the office to sign contracts, but to call them when they were ready for service. But this procedure has been stopped because it leaves a prospect with the impression that the sales-

man is receiving a commission directly from the money the customer pays. In other words, the prospect thinks that he is being asked to pay for needless sales service. So prospective customers are asked to call at the office to sign contracts if possible. On request, however, a contract will be taken to the customer.

Although it does not publish the fact locally, the company allows each customer the privilege of forgetting the prompt-payment discount date once a year and does not penalize for this forgetfulness unless it happens more than once in twelve months. Payment of bills at outlying banks and drug stores is urged, since it reduces congestion at the company's general office on the discount days.

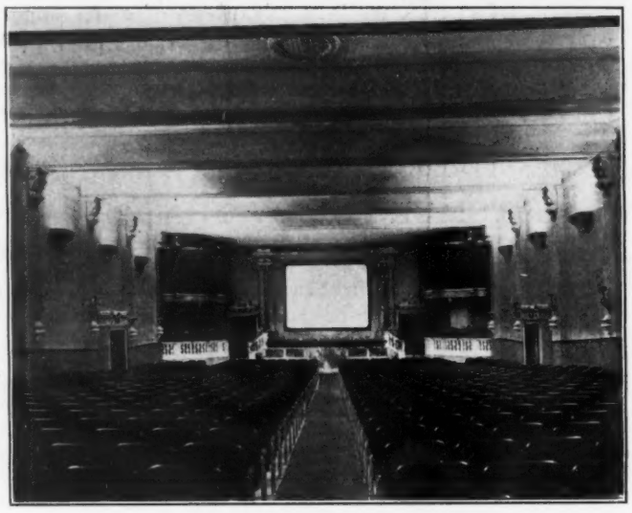
For the further convenience of its patrons the company supplies duplicate bills on request. The station from which these bills are furnished is on the main floor of the office building, so that the forgetful customer is not put to any great inconvenience. That this service must be helpful to customers is evidenced by the fact that last year saw 35,456 requests for duplicate bills. Of these 19,747 were made because the customers stated bills had not been received, and 9077 customers stated that bills had been received but later lost.

It is a rule with the company that service must be rendered to residence customers in less than twenty-four hours after the contract is signed. To make possible such rapid action on contracts, a great deal of time and thought have been given to simplification of order work. While the customer making application is waiting a few minutes at the counter a boy determines his credit standing by checking the application against an open-topped file containing a list of uncollectable accounts and cut-off orders. Every two hours during the forenoon orders taken over the counter are transmitted to the meter installation department. Orders taken in the afternoon are put through the office routine by a night force and are placed in the hands of the meter department on the following morning.

Meters ordered out on a cut-off order are never removed in the afternoon. This practice has been adopted because it eliminates the possibility of any householder being by mistake deprived of service so late in the afternoon that it would be impossible to restore it before he had suffered considerable inconvenience.

When a customer orders his service discontinued he is issued a receipt in the form of a stub torn from the disconnect order. This stub is considered authentic evidence in case a dispute arises later regarding the time the disconnection was ordered. It has been found to prevent disputes and to provide an excellent check on the accuracy of the work of the company's employees.

These are some of the methods the company employs to insure good service to its patrons, but without the *esprit de corps* that prevails throughout the organization the officers believe the system could not accomplish its full purpose.



CHICAGO THEATER AUDITORIUM LIGHTED BY SIDE-WALL REFLECTOR BOXES

Theater Lighting from Side-Wall Indirect Reflector Boxes

BY J. L. STAIR

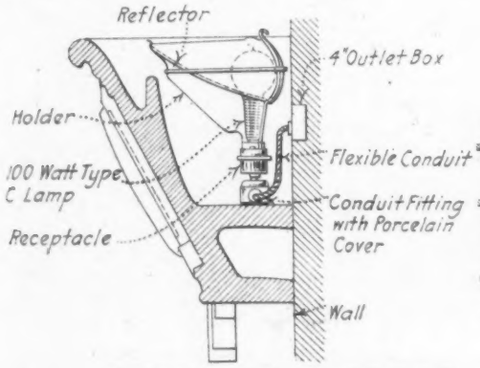
Although very pleasing results can be obtained with hanging fixtures, the present tendency of interior lighting for theaters is toward the use of other than ceiling outlets. One of the newer treatments is that in which the illumination is from concealed sources, located in side-wall brackets, boxes or coves. With no ceiling fixtures the auditorium looks much higher.

The auditorium of the Germania Theater, Chicago, is lighted by such side-wall boxes which conceal the indirect lighting units and reflectors. The lamps are mounted in a number of wall lighting boxes arranged as shown in the sectional view.

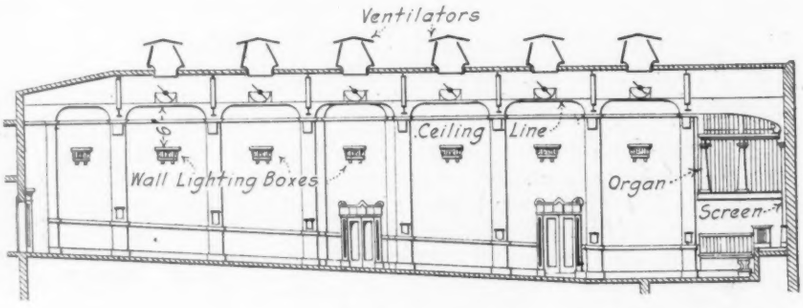
Each group of three lamps is wired on two separate circuits; the center unit in each box being supplied from one circuit for "dim" illumination during film productions, while the other two are on a separate circuit. The two outer units, together with the center unit, provide the brighter lighting for intermissions, and when it is desirable to have the room darkened for the pictures the center units are used alone.

The auditorium of this theater is 60 ft. wide and 100 ft. long, and the average ceiling height is about 24 ft. There are fourteen side-wall boxes in all. Each reflector contains a 100-watt gas-filled tungsten lamp. Fourteen hundred watts, or 0.21 watts per square foot, is required during the performance to provide the dim illumination.

The architect for the Germania Theater was Adolph Woerner, and the electrical contracting work was done by the Emmons Electric Company, Chicago.



SECTION THROUGH REFLECTOR BOX



ELEVATION OF AUDITORIUM SHOWING POSITION OF LIGHTING UNITS

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

TEMPERATURE DISTRIBUTION IN ELECTRICAL MACHINERY

A Review of B. G. Lamme's Recent Analysis of the Fundamental Principles of Heat Distribution and Temperature in Electrical Apparatus

A RECENT A. I. E. E. paper by B. G. Lamme on "Temperature Distribution in Electrical Machinery," is of fundamental importance, as it discusses in some detail the underlying basic principles of heat generation, heat flow and heat dissipation on which the resultant temperatures at different points in electrical machinery depend. Compared with the usual problems of heat flow, discussed in text-books on thermodynamics, the problem for electrical machinery is rather complicated in that there are several different sources of heat generation, simultaneously active. Thus there is heat generated by losses in the copper conductors, obeying one law; while there is heat generated in the iron parts under a quite different law; and there may be heat generated by windage and friction, according to a third law.

Mr. Lamme first considers the general conditions of

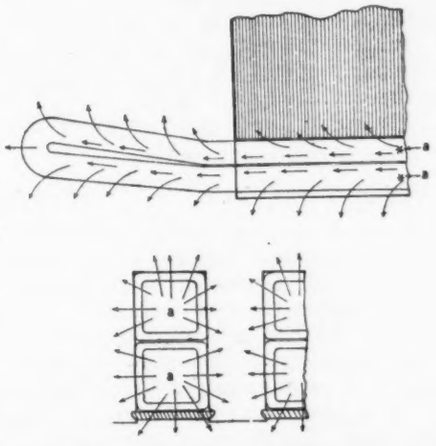


FIG. 1—ARMATURE SLOT WITH SURROUNDING IRON AND TWO SEPARATE COILS PER SLOT

heat dissipation from an armature coil. In Fig. 1 is represented an armature slot with the surrounding iron, and with two separate "coils" per slot, as is now the most common practice. Let it be assumed that the point *a* represents the "hot spot," or part at highest temperature in the apparatus. The heat from this part can flow along two general paths, namely, longitudinally through the copper conductor itself to the end windings, and thence to the air, and laterally through the insulation to the surrounding iron, or to the ventilating ducts. From the iron the heat flow is then through various paths to the external cooling air. Both the longitudinal and the lateral heat flow are discussed separately by Mr. Lamme in some detail.

In the discussion of the lateral flow of heat through the insulation to the iron Mr. Lamme points out that if a given amount of heat is to be conducted through a path of given resistance, the temperature in the heat-generating part will rise until heat is conducted away. Let Fig. 2 represent the temperature conditions in a section of an armature. Assuming, for example, the temperature of the copper inside the coil insulation as 100 deg. C., the iron temperature as 70 deg. C., and the air temperature as 30 deg. C., then the following conclusions may be drawn.

1. From the outer coil (the one next to the air gap) through the wedge to the air gap, the temperature drop will be 100 — 30 = 70 deg. C. Obviously, any temperature measurement made outside the wedge, next to the air, will approximate the temperature of the air and not of the copper. Any temperature measurement made beneath the supporting wedge will measure some intermediate temperature between the copper and the air. If the temperature drop through the wedge should be equal to that through the insulation, then a measurement underneath the wedge should show half the temperature drop through insulation and wedge, and obviously, the measured temperature would be far below that of the copper.

2. If the temperature is measured at the outside of the coil, between the iron and the insulation, it would approximate the average of the temperature of the iron and of the outside insulation, or practically the temperature of the iron. If the iron should be at different temperatures at the sides of the slot and at the bottom, then obviously different readings would be obtained, depending upon the location of the measuring device. It is evident that such temperature measurements give no indication whatever as to the true internal temperatures

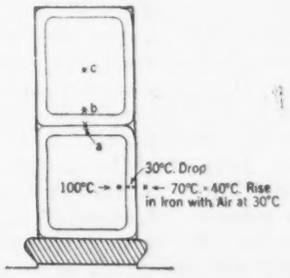


FIG. 2—TEMPERATURE CONDITIONS IN A SECTION OF AN ARMATURE SLOT

of the coil, for the heat flow and the resistance of the insulation are nowise involved in the measurement.

3. At a point, *a*, between the two coils, there should be but little heat flow through the insulation, unless the copper is comparatively narrow. If there is but little heat flow through the insulation at this point, then eventually the temperature at the point *a* must rise to approximately that of the copper in the two coils. Therefore, a measuring device located at *a* will approximate the temperature of the copper itself, and is, in general, a good indication of the hot spot at that part of the winding. Therefore, as a practical method of temperature determination, a thermo-couple located at *a* is about the most satisfactory device that we have. However, the location of the point *a* along the slot is also of importance on account of the longitudinal flow of heat in the conductor and the consequent temperature drop. In other words, the direction of heat flow in the coil itself, must be taken into account. Therefore, a thermo-

couple, located as above, is only satisfactory when the general location of the hot spot is known beforehand. This is usually determined, in a general way, for a given type or line of machines, by locating several thermocouples along the slots.

With narrow slots and comparatively thin conductors, and especially with very heavy insulation, there is some flow of heat through the insulation which lies between the two coils, this heat passing out sidewise to the iron. In such case, the point *a* may be of somewhat lower temperature than the copper. It may happen also, in some cases, that, due to unequal losses and heating of the two coils in the same slot, one is at a higher temperature than the other. In such case, due to the heat flow between the coils, the temperature indication at *a* will not show better than an average of the two temperatures. Furthermore if the temperature at *c*, in a coil subdivided into many insulated conductors, is materially higher than at *b*, then the temperature indication at *a* may not be a close approximation to the maximum temperature.

Mr. Lamme then takes up the heat flow through the iron parts and the final dissipation of the heat to the air. With respect to the latter he points out that there is usually a considerable drop in temperature from the solid surface to the cooling air itself, the amount of such drop depending upon the ventilating conditions. In practice, there appears to be a film or layer of air which adheres very closely to the solid surfaces. This forms a sort of heat insulating film, retarding the flow of heat to the cooling air. In air ventilation, the effect of any considerable air movement over the surface appears to be that of scouring this hot film away from the surface and replacing it with a film of cooler air.

Mr. Lamme then discusses the equalization of temperature, some fallacies in temperature guarantees and errors in temperature measurement, and emphasizes in conclusion that no hard and fast rules can be made for determining the facts in the case, and that the best rules and methods now practicable are only approximate. The present limitations set for insulating materials are much higher than were considered practicable only a few years ago. This is not because the limits have been raised, but because, through a better understanding of the facts, the real upper limits of temperature as fixed by durability of insulation, are now known to be considerably higher than was believed to be the case only a short time ago. If the real limits were in accordance with former beliefs, then all the evidence of the more accurate modern tests and data would indicate that the vast majority of the existing electrical machines should have "roasted out" comparatively early in their operation. The higher temperature limits were there, but were not recognized. Now we recognize them and attempt to make reasonable allowances for differences between the measurable temperatures and the actual hottest parts. The present method may be crude, but we are not going at it in a blind manner, as was formerly the case.

Formerly manufacturers took the real responsibility for making a machine that was safe for the service, whatever the guarantees called for. To-day the responsibility is still his, but he is attempting to educate the public to a knowledge of his real problems, and to a recognition that temperature determination is far from being an exact art. There is no sharply-defined line between good and bad in the insulating materials as affected by temperature, consequently there is no sharp line between safe and unsafe temperatures.

The complete paper of Mr. Lamme, which will repay studying in detail, is published in the November, 1916, issue of the *Proceedings* of the American Institute of Electrical Engineers.

Lamps and Lighting

Effect of Brightness and Contrast in Vision.—P. G. NUTTING.—A paper presented before the Illuminating Engineering Society, in which the author outlines those relations between lighting and good seeing which center upon the psychophysical laws relating perception to the flux density of light at the retina, all other relations between lighting and seeing being simple physical and geometrical optics. Of chief interest at every brightness level are (1) the lowest perceptible brightness, (2) the faintest perceptible contrast, and (3) the highest comfortable brightness. Precise data on threshold, contrast and glare sensibility are given over the whole visual range (from 10^{-6} to 10^{+4} millilamberts). A new quantity, the discrimination factor, a direct measure of seeing quality, is defined.—*Transactions, Illumin. Eng. Soc.*, Dec. 30, 1916.

Apparent Brightness; Its Conditions and Properties.—LEONARD THOMPSON TROLAND.—A paper read before the Illuminating Engineering Society. This paper is a discussion of brightness from the psychological and physiological points of view. Visual response is analyzed into successive stages, and the relations of apparent brightness with the "intensity factors" of these stages are considered. The measurement of the retinal image, the laws of variation of the sensitivity and selectivity of the retina for brightness, the Purkinje effect, and intensity factors in the optic nerve conduction are considered in the light of new experiments. Taken on experimental grounds the thesis is defended that brightness sensitivity as expressed by the ordinary "visibility curve" rests upon a single physiological process, which is independent of the mechanism of color perception. This proposition is applied to the problems of heterochromatic photometry in conjunction with the results of new measurements dealing with the methods of direct comparison and of flicker. The conceptions underlying the definition of "light" are analyzed from the point of view of the psychologist.—*Transactions, Illum. Eng'ing Soc.*, Dec. 30, 1916.

Generation, Transmission and Distribution

Westphalian Waterpower Plant.—E. TRIEBER.—An illustrated article on the Moehne Valley water-power plant in Westphalia in Germany. The Moehne a tributary to the Ruhr River, the flow of which is regulated by eleven reservoirs, the Moehne Valley reservoir being the largest, with a capacity of 130,000,000 cu. ft. of water. But as most of the water is only intermittently available the station must be worked in conjunction with some steam-power plant. The whole of the output of the hydraulic station is taken by the Westphalian Verband-Elektrizitätswerk in Dortmund, which also controls the working of the station. The greater part of the energy is transmitted at 25,000 volts over a distance of 33 km. (21 miles) to the town of Neheim, and thence to a transformer substation at Menden. Here there are four transformers, each with an output of 1500 kva., reducing the voltage to 10,000 for transmission a further distance of 38 km. (23 miles) to a power station at Kruckel, near Dortmund. The power stations at Kruckel and in the Moehne valley usually run in parallel. The yearly flow of water from the Moehne is about 255,000,000 cubic meters; about 53 per cent of this amount can be stored in the lake. The mean flow of water is about 7.8 cubic meters per second. The available fall varies from 33 m. to 13 m. according to the depth of water in the storage lake. The mean output may be taken at about 1200 kw., measured at the terminals of the generation, but as the output is only spread over the hours of the peak of the load the output is reckoned on a basis of four times this amount.

The Westphalian station, therefore, contains four machines, each of 1200 kw. capacity.—London *Electrician*, Jan. 19, 1917.

Installations, Systems and Appliances

Balancers for Three-Wire Direct-Current Systems.—THOMAS CARTER.—The first part of a full treatise on the design and theory of balancers for three-wire continuous-current systems for the use of students. The present installment deals with preliminary matters and gives the general theory of the balancer. After an introductory note the author deals with early three-wire systems, early types of dynamos for three-wire systems, the use of batteries as balancers, static balancers and rotary balancers, the three-wire system without the balancer, the equivalent resistance of a three-wire system, and the three-wire system with the middle wire connected to an elementary balancer. The article is to be continued.—London *Electrician*, Jan. 12, 1917.

Electrophysics and Magnetism

X-Ray Reflection and Atomic Structure.—A. H. COMPTON.—A highly theoretical paper on the intensity of X-ray reflection and the distribution of the electrons in atoms. In the first part of this paper an expression is derived for the energy of a beam of X-rays of definite wave-length which is reflected from a crystal. The result is in accord with that previously derived by Darwin, and shows that the intensity of the reflected beam depends not only upon the angle of reflection, but also upon the arrangement of the electrons within the atoms of the reflecting crystal. The form of the equation for the energy in the reflected beam is shown to be independent of the degree of perfection of the crystal and of the length of the wave-trains of which the X-rays consist. In the latter part of the paper a study is made of the possible distributions of the electrons in atoms which will account for the observed energy in the reflected beam of X-rays. It is shown that there is no possible distribution of the electrons which will lead to Bragg's empirical law for the intensity of reflection; it is found rather that any formula for this intensity must depend not only upon the angle of reflection, but also upon the wave length of the incident rays. Attention is called to the fact that Bragg's experimental data indicate differences in the reflection from certain crystals which can arise only from differences in the distribution of the electrons in the atoms of which the crystals are composed. Assuming a number of electrons in each crystal equal to the atomic number, and making certain plausible assumptions concerning the arrangement of these electrons in rings, it is found possible to account in a satisfactory manner for the observed intensities of the X-ray spectra. Although the particular distributions assigned to the electrons in the atoms of calcite and rock salt may not be the only ones which will account for the observed intensities of the X-ray spectra, it seems probable that these distributions are not far from correct. The results of this investigation seem to show conclusively that the electrons are not concentrated within a very small distance from the center of the atom, as is assumed in Crehore's theory of atomic structure. On the other hand, the conclusions arrived at are in good accord with the theory of the atom due to Bohr.—*Phys. Rev.*, January, 1917.

Units, Measurements and Instruments

Determining Transformation Ratio and Phase Lag in Current Transformers.—P. DE LA GORCE.—An illustrated description of a method for determining the ratio of transformation and the phase lag in commercial current transformers for various frequencies and for various adjustments of the constants of the secondary circuit. Fig. 3 shows the arrangement of the test. I_1 and I_2 are the primary and secondary currents of the transformer T under test. The primary circuit contains a non-inductive resistance R_1, an ammeter A_1 and the current coil of a wattmeter W_1, the potential coil of which is supplied from a voltage E_3. The voltages E_1 and E_2 are supplied by two machines coupled together in such a manner that the phase-angle between E_1 and E_3 can be adjusted to any desired value. The secondary of the transformer is closed through an inductance, L, and a non-inductive resistance, R_2, to represent the inductance and resistance of the measuring instruments supplied by the transformer; r and ρ are non-inductive resistances, and G is a vibration galvanometer. If the primary and secondary current were in exact opposition the determination of the ratio of transforma-

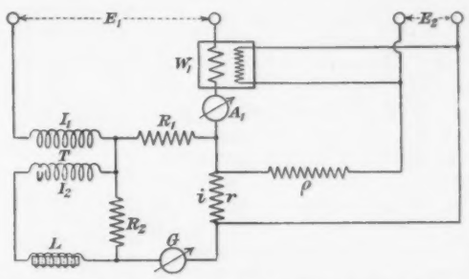


FIG. 3—ARRANGEMENT OF TEST FOR DETERMINING TRANSFORMATION RATIO AND PHASE LAG IN CURRENT TRANSFORMERS

tion would be given by the relation $R_1I_1 = R_2I_2$ if R_1 and R_2 were regulated until the galvanometer G gave no deflection. In reality the vector R_1I_1 makes an angle α with the vector R_2I_2 (supposed to be reversed) and a difference of potential equal to the vectorial difference between the two vectors is applied to the galvanometer. In order to bring the galvanometer to zero and measure α, the phase difference between E_1 and E_2 is adjusted until the wattmeter W_1 reads zero, thus showing that the current i in the resistance r is in quadrature with the current I_1, and then the resistance r and ρ are suitably regulated. Under these conditions we have

$$R_1I_1 = R_2I_2 \cos \alpha,$$

$$\tan \alpha = \frac{ri}{R_1I_1},$$

$$i = \frac{E_2}{r + \rho},$$

from which equations the ratio of transformation I_2/I_1 and the angle of phase displacement α can be easily deduced. Notes are added on several details of design and on precautions to be taken, and the results of tests are given. One result of these tests is that with the transformer in question doubling the secondary resistance changes the ratio of transformation by only 0.005, but that the angle of lag is considerably increased, especially at light loads.—From *Bulletin* de la Soc. Internat. des Elec., July, 1916, translated in abstract in London *Electrician*, Jan. 12, 1917.

System of Remote Control for an Electric Testing Laboratory.—P. G. AGNEW, W. H. STANNARD and J. L. FEARING.—In a laboratory in which a large number and variety of electrical instruments are tested, it is important that means be provided for the rapid and accurate control of the electric generators which provide the current for testing. In this paper an elaborate system of this kind which is in use at the Bureau of Standards is described. The control rheostats are not handled by the observers directly, but are operated by small motors which are controlled from any one of several laboratory rooms by means of small, multiple-lever switches.—*Scient. Paper, Bureau of Standards*, No. 293, Oct. 12, 1916.

Readers' Views and Comments

Radiation from Helical Tungsten Filaments

To the Editor of ELECTRICAL WORLD:

SIR: In connection with the interesting discussion of the radiation from helical tungsten filaments, given in your issue of Nov. 25, 1916, page 1062, attention may be called to the issue of May 19, 1910, Vol. 55, page 1314, especially Fig. 2, which shows graphically the physical reasons why tungsten (and, in fact, all metals which have a lower reflecting power in the blue than in the red) radiates selectively in the visible portion of the spectrum in such a way as to make the amount of radiation relative to that of a black body greater in the blue than in the red. This is due to the fact that in the blue the absorption (100-reflection), and hence the emissivity, is from 8 to 10 per cent higher than in the red.

In March, 1914, the problem was presented to me to search the infra-red emission spectrum of highly incandescent tungsten wire in the form of hair-pin and helically wound filaments to determine whether there is a difference in the shape of the spectral energy curves. The 1914 data appeared in your issue of Nov. 28 (Vol. 64, page 1048). The measurements with the optical pyrometer were described in the terminology appropriate to that instrument, *viz.*, "apparent temperature." But it was not my intention to convey the idea that "this increase in brightness was the same as that due solely to increased temperature," for even at that early date experimental data (Worthing, *Phys. Rev.*, 3, page 67, January, 1914) indicated that the observed increase in brightness of some 40 to 50 per cent from within the helix could not be explained solely on the basis of a higher temperature within the helix.

The results of my first tests may be summarized as follows: (1) For reasons to be fully explained in a more complete paper the tests with the microscope pyrometer were not decisive enough to settle the question of reflection from within the helix. (2) The polarization test seems a fair test of this phenomenon (reflection), although some of the polarized light might be due to direct emission. (3) The infra-red tests show that the unsymmetrical spectral energy distribution is due to a great extent to "blackening" of the radiation by reflection within the helix, although some of this blackening might be due to crimping of the inside of the turn of the wire.

In more recent tests all the measurements were made on the same filament, by projecting an image of a small area of the inside or the outside of the turn of the helical filament, upon the spectrometer slit, which was cut down to 1×0.5 man opening. The results obtained are shown in Fig. 1, in which curve *I* gives the spectral distribution of energy radiated from the inside, and curve *O*, from the outside of the turn of the helical filament of tungsten mentioned in the previous paper. These data thoroughly prove that the increased brightness of the light coming from the inside of the turn of the wire is due to reflection of light coming from three or more adjacent turns.

Measurements made with a physical photometer indicated that the light coming from a given area within the helix was 1.87 times as bright as from a similar area on the outside of the turn. On the assumption that the reflecting power of tungsten is 52 per cent at 0.55ω, this increased brightness can be produced by the superposition of light reflected from (and emitted by) three adjacent turns. The computed intensity would then be 1.94 as compared with the observed value 1.87 just mentioned.

Using the observed energy curve, *O*, and increasing the radiation at various wave lengths by the factor for three reflections gives curve *A*, which coincides very well with the observed curve *I*, of the energy from the inside of the turn. This close agreement is especially marked in view of the fact that no correction is applied to the reflecting powers of tungsten, which were observed at room temperature. Now, it is well known that in the infra-red the reflection from metals decreases with rise in temperature. For example, at 2.5ω, where a value of $R = 0.84$ (20 deg. C.) was used, if the reflecting power decreased to $R = 0.80$ at 2300 deg. C. (which is not improbable) then the observed curve *I* and the computed curve *A* would coincide within 2 per cent, which is as close as the experimental data at this point.

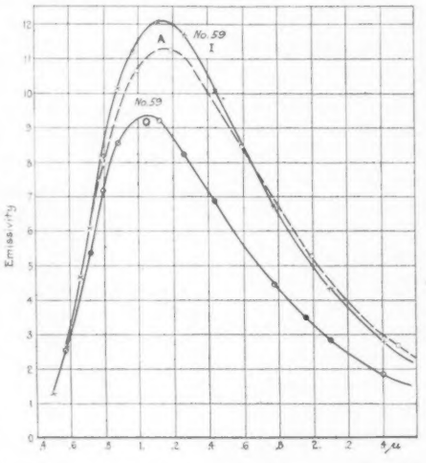


Fig. 1—Spectral distribution of energy radiated from the inside *I* and outside *O* of the turn of a helical filament of tungsten in a nitrogen-filled lamp.

To the writer the most striking thing is the increase in light efficiency introduced by actually increasing black body conditions when, as is well understood, an increase in light efficiency is to be sought by decreasing the infra-red radiation. In the present case the blackening of the radiation from the inside of the filament is 36 per cent greater than the radiation from the outside (in my previous communication this ratio was only 1.07, *i.e.*, 7 per cent greater, which was inconsistent with the idea of 80 to 100 per cent internal reflection). But since convection losses, in an incandescent hair-pin filament in a gas, cause a far greater dissipation of energy than that due to an increase in infra-red radiation (in reality a decrease in visual rays caused by reflection and absorption within the helix) introduced by winding this filament into a helix, we have in the present case an excellent illustration of increased light efficiency by increasing black body conditions.

W. W. COBLENTZ.

Washington, D. C.

Design of Dynamo-Electric Machinery

To the Editor of ELECTRICAL WORLD:

SIR: Your number of Oct. 21, 1916, contains what seems to be a criticism of a design of a 1000-kw. direct-current machine described in my book, "The Specification and Design of Dynamo-Electric Machinery." Prof. Alex. Gray is considering the most economical speeds of dynamos, without reference to the prime movers. Admittedly in this case, the ultra-high-speed motor or generator does not compare favorably with the moderate high-speed machine. But the 1000-kw. generator described by me is designed to meet the requirements of the steam-turbine designer, who can build a very much more economical turbine of 1000-kw. at 2750 r.p.m. than at 900 r.p.m. The saving in steam consumption alone would pay for the generator altogether. Provided a satisfactory 1000-kw. generator can be built to run at the high speed (and Professor Gray will admit that the constants of the machine in question are well within the limits prescribed by him), the question whether a gear should or should not be used between turbine and generator is one which is easily settled by considerations of first cost and efficiency. I think that the future will show that for sizes up to and including 1000 kw. at 600 volts it will be cheaper, more efficient, and generally more satisfactory to direct-connect the generator. The question largely turns upon commutator construction. With the right commutator construction, there is no difficulty in running at 10,000 ft. per minute. The brush drop at this speed can be made lower than is often found on low-speed generators. As for commutation, it is possible to make this highly satisfactory at these great speeds up to very much greater outputs than are at present contemplated.

MILES WALKER,

Professor of Electrical Engineering, The Victoria University of Manchester.

Manchester, England.

[This communication was inadvertently omitted from last week's issue, and should be read in connection with Prof. Gray's reply, appearing in that issue.—Editor.]

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

COUNCIL OF AMERICAN ENGINEERING SOCIETIES

Plans Under Way to Facilitate Co-operation Between the Engineering Societies and to Extend the Usefulness of Professional Engineers

At the annal convention of the American Institute of Electrical Engineers held at Cooperstown, New York, on June 24, 1913, Dr. William McClellan presented a suggestion for the engineering profession, to form a national body representative in its membership of all national engineering societies. All trade and business organizations were to be excluded and the object of the society was to assist in the realization of the ideals of the engineering profession and to extend the usefulness of the professional engineer as a servant of the community.

Any national society of professional engineers with or without associated grades of membership was to be eligible and representatives from these societies were to be elected annually. The new organization was to be supported by an annual assessment of members of societies on a per capita basis.

Among the functions then outlined by Dr. McClellan were the following: The engineering association was to arrange an annual convention of engineers for discussion of engineering in general, of the engineering profession and of any relative subjects except scientific and technical subjects such as would naturally and properly come before the meeting of member societies. The association would hold not less than two meetings each year at which the objects of the association would be discussed and recommendations forwarded to the member societies if desirable. It would investigate and report on with recommendations any subjects that might be referred to it by a member society. It would also appear at congressional, legislative or other hearings where it may be desirable for the purpose of assisting in a proper decision of questions affecting the public good. It would make recommendations at any time to public officers as to policy in relation to matters in which the engineering profession may be interested on its own account or on account of its share in responsibility for public progress.

An organization such as then outlined is now in process of formation and was referred to by President Buck of the American Institute of Electrical Engineers at the convention of that body in New York City this week. As outlined by President Buck the functions of this engineering council are to provide for convenient co-operation between engineering societies for the proper consideration of questions of general interest to engineers and to the public and to provide the means for united action of questions of common concern to engineers.

Although at this writing the actual formation of such a council has not been consummated it is generally understood that its organization will not be long deferred. Preliminary meetings have already been held and a tentative set of by-laws drawn up. Among the national engineering societies which in all probability will be eligible for membership are the following: American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Mining Engineers, American Chemical Society, American Electrochemical Society, American Institute of Chemical Engineers, United Engineering Society, American Electric Railway Association, American Railway Engineering Association, American Society of Heating and Ventilating Engineers, American Society of Refrigerating Engineers, Mining and Metallurgical Society of America, National Electric Light Association, Society of Naval Architects and Marine Engineers, Society of Automobile Engineers, Aeronautical Society, Illuminating Engineering Society, and the American Gas Institute.

WATER-POWER LEGISLATION BY PRESENT CONGRESS UNLIKELY

Senate Conferees, Unable to Agree on a General Dam Bill, Are Discharged and Appointed as New Conferees

Senator Shields, on behalf of the conferees of the Senate, and Representative Adamson, on behalf of the House conferees, have presented to the two Houses of Congress a report that they are unable to agree on the general dam bill, with the implication that there is no chance of its passage by this Congress. After a debate in the Senate on the question of whether the conferees should be discharged, it was agreed that they should be, and Vice-President Marshall appointed new conferees, namely, Senator Shields, Senator Bankhead and Senator Nelson, to see what they could do in framing a new bill which might meet some of the objections of the House conferees, discharging the old conferees, who were the same men. The significance of this parliamentary move, is that the new conferees are not bound to abide by the old bill passed by the Senate, and they have the power to bring in a new bill.

When the report of the disagreement of the conferees was presented in the House of Representatives by Judge Adamson, the House agreed to accept the report and discharge the House conferees. No provision was made for naming new House conferees. The effect of this action was to send the papers in the matter of the bill back to the Senate, as the action was taken on Senate Bill 3331, popularly known as an amendment to the general dam act, which originated in the House, and for which Senate Bill 3331 was a substitute. This is the proposed amendment to the act of June 23, 1910, to regulate the construction of dams across navigable waters, and to provide for the improvement and development of interstate commerce.

It will be necessary under these circumstances for the Senate to bring in a new bill. There is now nothing before the House to consider.

The impression continues in Washington among the best-informed circles that there will not be any water-power legislation at this session of Congress. One well-informed man, who did not care to be quoted, stated to a representative of the ELECTRICAL WORLD in Washington on Wednesday night that it might be to the interest of advocates of water-power legislation to

concentrate upon those who are to be members of the next Congress, and to pay attention, in this connection, to the possibilities in general preparedness and defense measures, with a view to co-ordinating the interests of water-power legislation advocates and additional defense measures advocates. In view of the international situation it seems to be certain almost beyond the shadow of a doubt that an extra session of Congress, with the greatly changed new Congress in their seats, will be called. It is believed in Washington that the new Congress in all probability will be almost a continuing body.

INDUSTRIAL MOBILIZATION CONTINUES ON LARGER SCALE

Censorship Liable to Go Into Effect to Prevent Papers from Printing News of Activities in the Industries

The mobilization of industrial resources, as a consequence of the international situation created by Germany in the renewed threat of ruthless submarine warfare has continued in Washington during the past week. Perhaps it is more proper to say that this mobilization has continued on a larger scale throughout the country under the direction of the national government at Washington.

The Council of National Defense has held various meetings in Washington with its advisory commission. The council gave out a statement showing what the organization of its work will be, in the case of eventualities, and what its present preparedness now is, in which it is announced that Hollis Godfrey will be chairman of a section of the work devoted to science and research, including engineering and education; Howard Coffin will be chairman of a section which will be occupied with munitions and manufacturing, including standardization and industrial relations, and Bernard Baruch will be chairman of the section devoted to raw materials, minerals and metals.

Representatives of trades, business and professions are being asked to deal with these men directly for the discussion of problems in industrial mobilization which may affect the national welfare. The time is rapidly coming, a Washington correspondent of the ELECTRICAL WORLD reports, when there will be very little, if any, publicity given to these measures of industrial mobilization for national defense. In other words, a censorship is liable to go into effect any day. Already certain steps have been taken by the government in regard to censorship and the plans for an extension of this precaution are upon a scale which will preclude the possibility of business men obtaining news of their industries from the daily newspapers. Even now, the news sent from Berlin by wireless is being censored by the State Department before publication in this country, and the proposed act of Congress providing for a general censorship is ready for rapid passage by Congress. In these circumstances, the best Washington opinion is that leaders in industry will do well to place themselves in personal communication with the government, without waiting "for any eventuality."

Irrespective of the international political situation, which has heretofore seemed to be based upon a waiting policy, so far as the government is concerned, with the possible idea that an "overt act" might bring about eventualities, reports from Washington show that administration officials are beginning to take stock of the cumulative effect of incidents, which, one administration official said Wednesday night, are to be likened to "the whereases in the Declaration of Independence."

INADEQUATE APPROPRIATIONS HANDICAP PATENT OFFICE

Commissioner Ewing in His Annual Reports Outlines Conditions Affecting His Office and Asks for Increased Allowance

Protests against inadequate appropriations for the personnel of the patent office are voiced by Commissioner Thomas Ewing in his annual report to Congress on conditions at the office of which he has charge. The tremendous work and self-supporting character of the office are contrasted in his report with what the commissioner claims to be the utter indifference on the part of Congress. A doubling of present appropriations is recommended.

Having pointed out that the receipts of the office exceeded expenditures provided for by the last appropriations by $228,173.03, and that the office has succeeded in materially reducing the vast number of pending applications, Mr. Ewing vigorously protests against what he claims to be the failure of Congress to duly consider the important work which is carried on at the office.

"The conditions in the office respecting the examining corps have been steadily growing worse relative to the amount of work which the office has had to do during the last quarter of a century," says Commissioner Ewing in his report.

"In point of training the showing is excellent; 85 per cent of the examiners and assistant examiners are graduates of colleges or technical schools; 43 per cent are members of the bar and more than 11 per cent in addition have had a thorough course of study in law, and more than 20 per cent in addition are studying law, so that 75 per cent are either trained in law or are in course of training.

"But the comparison of the size of the examining corps in the year 1890 with the present time and of the extent of the searches at these two dates presents a deplorable situation.

"In 1890 there were 189 members of the examining corps, of whom thirty were examiners. The assistant examiners who make the searches numbered 159. Each assistant had to report on 251 applications per year.

"In 1916 the corps numbered 367, of whom forty-three were examiners and 324 assistant examiners. Each assistant must report on 210 applications per year."

Mr. Ewing goes on to point out by a series of comparative statistics that the force relative to the work which it has to do is less than 50 per cent to-day what it was in 1890 because of the greater volume of search now necessary.

"In order that such a situation may be met at all," he goes on, "it is absolutely essential that the best method of classification should be adopted, the classification completed and kept up to date. Yet when I laid all of these facts before Congress and pointed out, as indicated in an earlier section of this report, that at the present rate of reclassification now going on it could not be completed in under twenty-five years, I succeeded in obtaining no relief whatsoever. Every recommendation that I made during the past year has been refused.

"I can attribute this indifference of the Congress in respecting my suggestions to lack of information as to the situation, and I therefore submit for the consideration of Congress the following facts:

"This office deals with all the effort of the world in every field of industry to advance the useful arts."

The great interest involved in the successful conduct of the patent office, not merely of private, but of public

concern, are then illustrated by the commissioner by a series of examples.

"All of this vast development," he continues, "comes before the office to be passed on, not by a group of men with time to study and keep abreast of what is being done, but by men whose entire effort is devoted merely to the task of keeping up with the enormous flood of applications which they must pass on, and the mistakes and oversights, of which, under the circumstances, there are inevitably many, cause enormous disturbance of business.

"Our admirable system of granting patents on examination was established primarily to safeguard the public interest by the avoidance of unwarrantable grants. It was originated by this government eighty years ago. At that time the system, both in this country and abroad, was to make grants on registration.

"Since we adopted our present system in 1836 it has been adopted by other enlightened industrial nations.

"The Congress, by withholding adequate appropriations for this office, is, in effect, transforming our system into the old system of granting patents on registration, while at the same time the safeguards of a registration system necessary to the public interest are not provided.

"After a most careful study of the conditions in the office during the past three years I feel no doubt that it will pay the public without regard to the fees collected if the amount spent on the office were doubled."

EDISON CELEBRATES HIS BIRTHDAY WITH EMPLOYEES

Notable Men in the Electrical Industry Also Pay Him Homage, and He Is Presented with a Huge Birthday Cake Symbolizing His Chief Inventions

Many plans were proposed for the celebration of the seventieth birthday of Thomas A. Edison, but the only one which the ever-young and indefatigable inventor would entertain was that of his own employees out at the works at West Orange, where a great variety of miscellaneous industries have grown up under his personal direction and management, carried on in a group of vast buildings which are probably the best example that exist in the world to-day of cement structures of their kind.

The Edison birthday falling on Sunday, the dinner to celebrate it was held on Saturday, Feb. 10, and in order to secure space big enough for the purpose, a whole floor was cleared in the Edison storage-battery building, some 600 ft. long, where gathered about 1800 male employees, some sixty guests and old associates, and one woman—Mrs. Edison. The reception given to the "Big Boss" on his entrance to the huge dining hall was one long to be remembered for its enthusiasm. Several special features distinguished the occasion, including telegrams of congratulation to Mr. Edison from all parts of the world, among them being the following letter from President Wilson, regretting his inability to be present:

"I wish with all my heart that I might be present to take part in celebrating Mr. Edison's seventieth birthday. It would be a real pleasure to be able to say in public with what deep and genuine admiration I have followed his remarkable career of achievement. I was an undergraduate at the university when his first inventions captured the imagination of the world, and ever since then I have retained the sense of magic which what he did then created in my mind. He seems always to have been in the special confidence of Nature herself. His career already has made an indelible impression on the history of applied science, and I hope that he has many years before him in which to make his record still more remarkable."

One item was a testimonal casket from Missouri with 35,000 signatures, from the Governor of the State and citizens. A delightful poem was read from Charles L. Edgar of the Boston Edison company. A huge birthday cake was presented by John W. Lieb on behalf of

SEVENTIETH-BIRTHDAY CAKE OF THOMAS A. EDISON

the New York Edison Company, and all of the 1861 guests got a piece of the cake, which, however, strange to say, remained outwardly intact and uncut, it and its panels of Edison plants and inventions remaining complete for the real domestic celebration next day.

The cake was 40 in. in diameter or 10.5 ft. in circumference, with a height of 40 in. It had on it seventy miniature electric candles, lighted from Edison storage batteries, symbolic of Mr. Edison's seventieth birthday. On the top of the cake was the figure of Liberty lighted by a tiny incandescent lamp representing a torch. The general color scheme of the frosting and medallions on the cake was white, yellow-orange and ivory. The cake had three decorative bands, two with appropriate dedicatory inscriptions, and the band around the base containing twelve plaques symbolic of Mr. Edison's principal inventions, including the incandescent lamp, storage battery, moving picture machine, telephone, bipolar dynamo, electrolytic meter, phonograph, cement mill, cement house, stock ticker, electric locomotive. Four medallions with the bust of Mr. Edison and the official seal of the United States typified his patriotic service to the country.

Vocal and instrumental talent of all kinds was provided by the artists and employees connected with the affiliated Edison interests of the Orange works. The beautiful indirect lighting arrangements were furnished by the Edison Lamp Works of the General Electric Company at Harrison, N. J. The Edison band gave performances throughout the evening, including an original Edison march by its leader, Professor Campione.

A. I. E. E. MID-WINTER CONVENTION

Internal Temperature of Generators—Use of Reactors —Motor Control and Electric Strength of Air Among Important Topics Discussed

At the fifth annual mid-winter convention of the American Institute of Electrical Engineers held in New York City on Wednesday, Thursday and Friday of this week—eleven interesting papers on a variety of scientific and practical engineering subjects were presented. The general scheme of the program, which facilitated the discussion of the problems brought up, was a grouping of the papers into a standards session, a protective devices session, an electrophysics session and two motor control sessions with a lecture on Thursday evening which took up engineering problems brought about by the present international crisis and a special talk on phases of modern physics. All sessions were well attended, the total registration being about 500 members and guests.

President Buck's Remarks on Engineering Co-operation

In opening the meeting on Wednesday morning President H. W. Buck reviewed developments in the industry since the general meeting last June in Cleveland, Ohio, and commented especially on the progress, brought about by engineers and scientific bodies which has resulted in a closer co-operation between engineering and pure science. He called attention to a recently organized section of the Society for the Advancement of Science which will be devoted to engineering problems and to the plans now under way for the creation of an organization that will be known as the Engineering Council for United Engineering Societies. This body will represent the interests of all existing societies and be the means through which all engineers can express themselves on public and engineering matters relating to human affairs. A new phase of co-operation open to all engineers which has been brought about by the present international crisis was also mentioned, namely, the assistance that can be rendered our government in carrying out preparedness plans. A committee of the institute will have charge of this work and all members through a general classification of their interests and ability will be given an opportunity to take active part in developments as they are worked out by the government.

Following President Buck's address, Dr. C. R. Mann of the Carnegie Institute of Technology outlined the report of the committee on engineering education which will shortly be presented in final form. Dr. Mann stated that the committee during the past three years has analyzed the basis on which engineering schools were started and has attempted to determine wherein their aims and work differs from the conception laid down by Professor Rogers for the Massachusetts Institute of Technology in 1860.

Standards Session

The paper on "Internal Temperatures of Alternating-Current Generators," by Ralph Kelly, scheduled for the Wednesday morning session, was ably abstracted in the absence of the author by Prof. Alex. Gray. The author discussed the theoretical considerations involved in the calculation and measurements of internal temperatures of machines to explain the wide divergence between internal and surface temperatures of different classes of generator stators. A method of calculation for internal temperatures was given which was based on simple heat laws and on data obtained from many tests. By means of tests and of parallel calculations, the effect on the internal temperatures of changes in frequency, core lengths, thickness and quality of insulation, armature current density and core densities was explained. The author pointed out that the difference in the internal temperature rises of generators of different frequencies is caused mainly by the difference in the core loss. He showed by data that in a 50-cycle generator the losses are considerably greater than in a 25-cycle generator both having the same core length and armature densities, with the core densities in the 50-cycle generators slightly smaller. The temperature difference in the two machines due to the increased iron loss caused by the higher frequency is accounted for nearly by the temperature rise in the lower section of the tooth.

It was explained that a change in core length affects the initial temperature in two ways. It changes the volume of armature material to be ventilated and to a lesser extent it changes the proportion of heat transmitted to the coil ends. Of the two effects the change of armature material to be ventilated with a change of core length is the most important. Current density has an important direct bearing on internal temperatures since it largely determines the heat loss that must be transmitted through the insulation. The tooth and core densities have a similar effect on the internal temperature as the generator frequency since both affect the copper temperature through the core loss. The author concludes his paper by stating that although the wide divergence between surface and initial temperatures of different classes of generators is regular and can be justified, it is plain that there is no one average figure that can be used for that difference for all classes of alternating-current generators.

The following took part in the discussion of this paper: H. G. Reist, Schenectardy, N. Y.; Prof. Comfort A. Adams of Cambridge, Mass.; W. F. Dawson, Lynn, Mass.; H. M. Hobart, Schenectady, N. Y.; and Prof. Alexander Gray, Ithaca, N. Y.

Professor Adams outlined the work of the standards committee of the Institute in promoting the need for a consideration of internal temperatures when rating generators and explained some of the differences of opinions held by operating engineers. He criticised some of the assumptions made by the author for the basis of his calculations as being difficult to determine and check. He referred particularly to the velocities of air moving over the surfaces considered and pointed out how difficult it is to employ constants or formulas that are accurate for machines of various types and proportions.

Mr. Dawson explained the value of temperature coils for checking armature losses. He also emphasized the need of considering windage loss which he maintained is about equal to the core loss, with the core loss from 2 to 2.5 times the copper loss.

Mr. Hobart substantiated the opinions of other speakers in reference to the difficulties in investigating accurately the internal temperatures of machines, stating that there is a variation of from 10 per cent to 20 per cent in results secured by the different methods which are available. He warned against placing too much faith in temperature detectors, explaining that their greatest virtue was reliability and as aids in indicating variations in temperatures, rather than furnishing a means of detecting accurately temperature values for hot spots. In commenting on the effects of frequency on internal temperature, Mr. Hobart stated that frequency times operating density was a rough measure of the core loss and therefore the internal temperature of machines of different types.

Professor Gray pointed out that the effect of insulation tightness was to make it possible to make use of higher copper densities for the same temperature gradient. He questioned the formula given by Mr.

Hobart that the core loss variation may be taken as the first power of frequency and density, pointing out that the curve of core loss against density is not a straight line as it might be inferred from such a relationship. He stated that high temperatures in machines are not new developments, some old machines having operated successfully mainly on account of liberal design and the fortunate use of mica insulation.

ELECTROPHYSICS SESSION

At the session held Thursday morning, the three papers presented dealt with the following subjects: "Corona and Rectification in Hydrogen," "The Electric Strength of Air," and "Oscillating Current Circuits by the Method of Generalized Angular Velocities." The first paper, which was prepared by J. W. Davis, Urbana, Ill., and C. S. Breese, took up an investigation of the formation of corona in hydrogen between a wire and a concentric cylinder.

The aim of the second paper by J. B. Whitehead, Baltimore, Md., and W. S. Brown was to make a careful determination of corona-forming voltages for alternating and for positive and negative continuous voltages in the same apparatus and under the same conditions. The observations on the negative corona were found to give values higher than any heretofore obtained. Qualitative indications of the correctness of Townsend's theory of ionization by collision were given.

V. Bush, Chelsea, Mass., the author of the third paper, by generalizing Kirchoff's law obtained a simple method of determining generalized angular velocities, frequencies and decrements of free oscillation.

MOTOR CONTROL SESSIONS

Four papers were presented at the morning and afternoon sessions on Friday, two dealing with the control of direct-current motors and two with induction motor operation. "Industrial Controllers with Particular Reference to the Control of Direct-Current Motors," was the subject of a paper presented by H. D. James, Pittsburgh, Pa., in which he outlined the results of a number of tests on standard motors equipped with automatic starters to investigate the conditions when a direct-current shunt motor is started from rest and the effect on: (1) the load driven by the motor; (2) the power supply; and (3) the motor operation. A number of oscillograph curves were shown for the performance of motors rated at 15 to 20 hp. at 230 volts.

The second paper on direct-current motors, written by K. L. Hansen, was a mathematical analysis of starting characteristics. Mathematical expressions for current, speed, torque and power at any time during the acceleration period were derived for a shunt, series or compound motor connected to a supply circuit.

A number of transient conditions existing in asynchronous machines immediately after certain changes in the circuit connections are made, were described in a paper by R. E. Hellmund, East Pittsburgh, Pa. The principal subjects which were considered are undesirable peak currents, which may be caused by the damping effect of the short-circuited rotor windings and the overvoltages, obtained with certain control arrangements.

In the paper by A. A. Gazda it was shown that continuous operation of wound-rotor induction motors with unbalanced external secondary resistance is feasible. The effect of such operation upon power factor and heating was discussed and curves were presented showing the performance of polyphase motors with single-phase secondaries.

PROTECTIVE DEVICES SESSION

Two important practical papers presented at the protective devices session on Wednesday afternoon revealed the results of recent studies of the performance of current-limiting reactors with different layouts in hydroelectric and metropolitan generating stations.

According to J. Allen Johnson, Niagara Falls, the amount of reactance required for protective and disturbance-localizing purposes is of the same order of magnitude as that which will produce instability of synchronism, so no installation of reactors can be safely undertaken, at least in hydroelectric plants, without a thorough preliminary investigation. First of all the protective and localizing functions of reactors are quite distinct. The former, since all the evil effects of heavy current—mechanical forces, heating, etc.—are proportional to the square of the current, is measured in terms involving the square of the total reactance; and the latter is measured in terms of the first power of the reactance involved.

Considering the results of a short-circuit which originated within 600 ft. of Quarry Street station and was followed by another on the same line inside the station (Chicago), P. B. Juhnke said that the influence of reactors must be pronounced exceedingly beneficial. Despite the nearness of the disturbance to the Quarry Street station not a single piece of generating station apparatus was disabled as was almost invariably the case before reactors were installed. Even on the section directly affected everything was ready for immediate resumption of service as soon as the trouble was cleared. Furthermore, no evil results attended the operation of the system during and after the trouble; no oil switches failed; and, most important of all, comparatively little load was interrupted on the sections protected by the sectionalizing reactors.

The paper presented by Max H. Collbohm, Madison, Wis., pointed out the danger to which Y-connected transformers, connected with long transmission lines, are exposed through the building up of excessive potentials at the neutral under conditions of lightning disturbance. This, the author explains, is due to the neutral acting as a reflecting point and allowing the potential to build up to three times the individual potentials induced on the separate lines. As a remedy for such trouble, the author recommends the connection of a sphere gap between ground and neutral.

All three of the foregoing papers were discussed at the same time by F. H. Kierstead, Pittsfield, Mass.; H. R. Woodrow, New York; L. F. Blume, Pittsfield, Mass.; A. R. Cheyney, Pinellas Park, Fla.; W. R. Bullard, J. B. Taylor, New York; R. F. Schuchardt, Chicago, and Comfort A. Adams, Cambridge, Mass. Mr. Woodrow pointed out the advisability of basing the rating of bus reactors on some definite current—either that of one generator or the total carrying capacity of busbars. Mr. Cheyney presented a written discussion in which he emphasized the need of bus reactors and cited a few advantages of feeder reactors. Mr. Taylor called attention to the definite relation between synchronizing power and reactance. In addition he expressed the belief that Y-connected transformers are no more vulnerable to lightning trouble than delta-connected units and that the potential at the neutral will not build up to three times that impressed on the lines due to lightning disturbance just because three circuits join at the neutral. Mr. Summerhayes favored comparing the effects of reactors by basing their performance on that obtained when the synchronizing power is the greatest. Mr. Adams likened a bus reactor to a mechanical coupling between two generators. If the reactance is too low (comparable with a rigid coupling) the stress imposed on the machines and system during synchronizing may be severe whereas too high a reactance (comparable with a flexible coupling) may reduce the synchronizing power too much.

NEW OPPORTUNITIES FOR ELECTRICS FOR CITY USE

Central Station Executives and Engineers Discuss Plans for Extending Use of Electrics Through Co-operation with Manufacturers and Better Selling Methods

That conditions warrant the intensive development of the electric vehicle at this time was evident in papers and discussions at a conference of central station executives held at New York City on Feb. 14, under the auspices of the Electric Vehicle Section of the National Electric Light Association. The meeting was called by Chairman E. S. Mansfield of the Electric Vehicle Section to obtain an informal discussion of the problems before the electric vehicle industry, and to secure advice of central station officials on further steps to be taken in promoting the electrical vehicle.

The whole problem of city transportation, it was stated, is up before the minds of the public and there is an opportunity for the central stations to get a share of this business, especially in the larger cities. A better understanding of the merchandising problems of the vehicle were also brought out in the discussion. As a result of the meeting Chairman Mansfield announced that the executive committee will shape plans for special committees to take up the suggestions along the lines laid down looking especially toward an enthusiastic meeting at the May convention.

Opening the program of brief papers and addresses W. H. Blood, Jr., first vice-president of the Electric Vehicle Association, traced the history of the battery car and the commercial efforts attending its introduction. Looking toward the future, he urged co-operation with the manufacturers to bring down the first cost of electric vehicles, the reduction of rates for charging so far as possible, and perhaps the establishment of some universal battery exchange system to facilitate vehicle operation.

Co-operation of All Interests

Frank W. Smith, Jr., vice-president of the United Electric Light & Power Company, New York City, declared that the central stations of the country have already done much for the vehicle, but made a plea for further co-operation of all interests concerned in the development of electric vehicle business—the car manufacturer, the battery manufacturer and the central station. He spoke of the success that has attended the use of fleets of electric vehicles in cities, and cited the co-operative plan proposed by the Ward Motor Vehicle Company in a four-page advertisement in the Electrical World of Feb. 10, a plan which, said Mr. Smith, follows closely along the lines of a plan which he himself had separately originated, but not published.

F. M. Feiker, editor of the Electrical World, spoke from the standpoint of a daily user of an electric passenger vehicle, and recounted his own experience in securing charging rates and garaging service for his car. Mr. Feiker urged that manufacturer and central station think more in terms of the customer who is to use the car, and that study be given to ways to make it easy to buy and easy to operate the electric.

The City Transportation Problem

The magnitude of the transportation problem in the larger cities of the country and the opportunity thus opened for electric vehicle haulage, was presented by W. P. Kennedy, consulting transportation engineer, New York City, in a paper analyzing the electric truck problem from the viewpoints of (1) the present activities of the central station; (2) the electric vehicle as a staple for which there exists a demand; (3) the introductory work of earlier days; (4) comparison of growth of electric vehicle business with other accomplishments in the central station field, and (5) activities of central stations to develop applications of electric vehicles based upon value of revenue produced.

Mr. Kennedy produced figures to show that the electrics now in use in thirty-five industries aggregate in value $36,000,000, and, consuming 90,000,000 kw.-hr. per year, return to the central station industry at 4 cents per kilowatt-hour an annual revenue of $3,600,000. Data was also tabulated showing the income from the passenger and commercial electric vehicles already in use in each of the principal American cities, and the income which might be obtained by converting the local horse population into electric transportation on the basis of an estimated income of $100 per year per horse "electrified."

Proposals to Promote Vehicle Development

In summing up the brief addresses that made up the prearranged program, Chairman Mansfield enumerated some of the disadvantages which have been charged against the electric vehicle, and suggested measures to bring about a greater development of the electric vehicle business. At various times proposals have been made, for example, to have central stations take over the control of the local electric vehicle business, to install universal battery and garage service, to initiate an advertising and publicity campaign, and to inaugurate local electric taxicab service as a means of interesting the public in the electric vehicle.

W. H. Johnson, vice-president of the Philadelphia Electric Company, expressed his personal interest in the electric vehicle, and declared that the high initial cost of the electric can be overcome by salesmanship.

W. W. Freeman, vice-president of the Union Gas & Electric Company, Cincinnati, pointed out that where active work has been devoted to the electric vehicle, excellent results have been accomplished, and said he hoped that the good work might go on.

A. W. Young of the Public Service Electric Company, Newark, N. J., declared his confidence in the electric vehicle, and told about the success of the New Jersey company in holding its electric vehicle customers by means of its inspection service.

George B. Foster, Commonwealth Edison Company, Chicago, declared that the electric vehicle business is well worth the effort, and cited the results that are being obtained in Chicago. He admitted, however, that prejudice against the electric vehicle often exists within an electric company's own ranks, and pointed out that unless this is checked such prejudice may be imparted by the employees to the public.

The Electric in New York's Transportation Situation

J. W. Lieb, Jr., vice-president of the New York Edison Company, called attention to the opportunity before the electric vehicle, offering as it does a solution for the transportation problem in cities. "The terminal charges in a metropolis like New York," said Mr. Lieb, "often total more than the cost of haulage." Where electric vehicles are sold in fleets, said the speaker, battery difficulties are relegated to second place.

"Serious problems incidental to the high price of coal and the rising cost of supplies of all kinds, make these trying times for the central station executive," continued Mr. Lieb. With such officials preoccupied with their larger administrative problems, said the speaker, it is not likely that promotion efforts just at this time will secure the attention and results that might be accomplished under more normal condiions.

Frank W. Frueauff of H. L. Doherty & Company,

New York City, particularly emphasized the points of "a mental attitude of prejudice" against the electric, and the need for better salesmanship, both of which had been mentioned by previous speakers. Mr. Frueauff suggested that the latter problem is one which should be laid before the Commercial Section of the N. E. L. A. for the development of a selling plan. He urged that the central station executive impress upon his salesmen the idea, for example, that each horse-drawn or gasoline vehicle is virtually an isolated plant which might be replaced by electric power.

Referring to the objection of high first cost of the electric vehicle, P. D. Wagoner, General Vehicle Company, reminded the audience that an electric truck's life is from three to five times that of a corresponding gasoline truck, and urged that the price of the gasoline truck be multiplied by such a factor when making any comparison of the first costs of the two types of vehicle.

NIAGARA FALLS INDUSTRIES PLEDGE GOVERNMENT SUPPORT

Electrochemical Plants in Position to Be of Great Service—Additional Protection Given to Power and Industrial Properties

Large electrochemical and power industries at Niagara Falls and Buffalo, N. Y., have pledged their support to the government in the present situation with Germany. Assurances have been given that in the event of war these valuable plants will be turned over to the government if they are needed. Several months ago the Industrial Preparedness Committee completed a survey of industries at Niagara Falls, at the direction of the Naval Advisory Board. This information is now available to both the Navy and War Departments. Almost every chemical and manufacturing plant in Niagara Falls is making some product that can be directly or indirectly used for war purposes. The products of many of the electrochemical plants are used in the manufacture of explosives. There are other plants that can be converted into munitions factories without much difficulty.

Francis A. J. FitzGerald, president of the FitzGerald Laboratories, Inc., of Niagara Falls and president of the American Electrochemical Society, told a correspondent for the ELECTRICAL WORLD that the society is willing to co-operate with any government department regarding the products of electrochemical industries and their adaptability to war purposes. He said the public relations committee of the society has already offered its services to the government. Mr. FitzGerald is chairman of the committee and F. Austin Lidbury of the Oldbury Chemical Company and Dr. E. G. Acheson of the Acheson Graphite Company are members.

"Niagara Falls electrochemical industries are prepared to render an invaluable service to the War Department," said Mr. Fitzgerald. "Of course a shortage of electric power is now seriously affecting these western New York industries, but in time of need all available power could be diverted to their use."

Chlorates, which are manufactured at several of the upriver plants, are used extensively in the manufacture of explosives. One plant makes chlorine for the Du Pont Powder Company's Niagara Falls branch. Electrodes used in many Canadian munitions plants are the products of the Star Electric Company and the Acheson Graphite Company.

The Schoellkopf Aniline & Chemical Works, Inc., of Buffalo, the largest manufacturers of aniline colors and coal-tar products in the United States, can easily be converted into the manufacture of chemicals for explosives and munitions. The company is now involved in the erection of additions and improvements to its plant involving the expenditure of almost $5,000,000. This is one of the largest users of electric energy in western New York.

Since the situation with Germany has reached such an acute stage additional protection has been given to these large electrochemical and power industries along the American Niagara frontier. At the Niagara Falls Power Company the force of guards has been doubled, and no one without authority is allowed to approach the grounds. At the Hydraulic Power Company similar conditions prevail, and a special force of armed guards has been retained by the large Niagara Falls electrochemical industries, which are co-operating with each other in the matter of protection. Because of the absence of the Seventy-fourth Regiment and the Third Field Artillery of the New York National Guard from Buffalo, it is reported that two New York City regiments will be moved to the American Niagara frontier to protect important industries. Both Buffalo regiments are on the Mexican border.

CO-OPERATION OF ENGINEERS FOR DEFENSE AND RESEARCH

Government Should Spend Large Sums in the Encouragement of Research, Says Elihu Thomson at Boston Banquet

Readiness to co-operate with the government in all emergencies, was the underlying thought expressed at the eighth annual banquet of engineers of Boston and vicinity, held at the Boston City Club on Feb. 7. Prof. C. A. Adams of Harvard University was toastmaster, and 451 engineers representing all branches of the profession were in attendance. Richard A. Hale, president of the Boston Society of Civil Engineers, urged comprehensive work along the line of water storage development by co-operation among beneficiaries. President Ira N. Hollis of the American Society of Mechanical Engineers outlined the work of the National Engineering Council with respect to preparedness, and Professor Adams emphasized the importance of instituting engineering standards in symbols and terminology as a means of bringing all branches of the engineering profession together for the public welfare.

Dr. Elihu Thomson, consulting engineer, General Electric Company, spoke emphatically regarding the importance of research in the field of pure science as leading up to engineering developments and triumphs. The present emergency, the speaker declared, emphasizes the need of encouraging scientific investigation. "The United States has much room for improvement in this direction, viz., supporting research for its own sake," said Dr. Thomson. He cited Lord Kelvin as an instance of a scientist and engineer combined and brought out the point that had Lord Kelvin's advice as a physicist been followed in the operation of the first Atlantic cable, the initial failure would probably have been obviated.

To neglect our industrial needs now, Dr. Thomson pointed out, would amount to political suicide. We should have been prepared years ago for such a crisis, he said, but in a democracy discussion in public threatens the progress of necessary secret measures of defense, since an appropriation ordinarily cannot be obtained without exhaustive airing of particulars. We need a definite program laid out by engineers and followed with all speed. Our government should spend large sums in the encouragement of research and every higher educational institution should include science in

its curriculum. The encouragement of research cannot be carried to excess. Before closing, the speaker illustrated how discoveries in pure science have laid the foundations of subsequent engineering progress from the time of Davy to the present day.

Dr. Hugh Cabot of Boston addressed the meeting upon his experiences in charge of a Harvard unit in France, and the evening closed with an illustrated lecture on submarines by E. H. Ewertz, superintendent of the Fore River Shipbuilding Corporation.

ELECTRICAL PORCELAIN DISCUSSED

Authorities at Joint Meeting of American Electro-Chemical Society and Other Chemical Societies Outline Developments in the Ceramic Industry

At a joint meeting of the American Electrochemical Society, American Chemical Society, and the Society of Chemical Industry, held at the Chemists' Club, New York City, on Friday evening, Feb. 9, several noted authorities on the subject of ceramics spoke on the history and manufacture of chemical and electrical porcelain in the United States. Among the speakers were Dr. Binns, director of the New York State School of Clay Working and Ceramics at Alfred, L. E. Barringer, president of the American Ceramic Society and chief engineer of the department of insulation of the General Electric Company, and Dr. Bleininger, U. S. government expert on clays and clay products.

Dr. Binns gave a brief résumé of the history of porcelain manufacture and then explained and illustrated the methods used here and abroad in the making of porcelain. Mr. Barringer told, with the aid of lantern slides, how porcelain insulators are made in the General Electric Company's insulator plant. The furnace used in this plant is in the shape of a long, narrow tunnel, the heat being applied to the products in the central section from the sides and top. The molds are placed on flat cars that pass through the tunnel at a specified speed. While in the tunnel the molds are heated and cooled gradually by this method. This furnace has been in continuous operation fourteen months. He mentioned the properties of porcelain and also several drawbacks, such as brittleness, being easily cracked, cannot stand very high heat, therefore unsuitable for places where there are heavy arcs. Dr. Bleininger enlarged on the properties of porcelain from the chemical standpoint.

FIRE HAZARD OF HOUSEHOLD ELECTRICAL APPLIANCES

National Board of Fire Underwriters Calls Attention to Fires Caused by Careless Handling of Small Devices

The National Board of Fire Underwriters has called attention to a new form of fire peril which has caused much destruction. Because of their convenience, small electric devices, such as pressing irons, curling irons, toasters, electric pads or blankets, electric plate warmers, and electric sterilizers or heaters are now to be found in almost every community. If these were used with proper care the danger would be negligible, but, unfortunately, a portion of their users do not realize the peril of leaving them in circuit when not in use. In such cases these devices tend to become overheated, whereupon they are likely to set fire to anything combustible with which they are in contact.

According to the fire underwriters most of these fires are small, but the aggregate loss is large, and occasional instances show extensive damage. Fires of this class furnish a special peril to life, being most frequent in dwellings and often breaking out at night. A characteristic example is that in which an electric pressing iron is left upon the ironing board, with the circuit closed and then forgotten. In such a case the fire may not occur until some hours later.

This form of hazard is already assuming large proportions. The Actuarial Bureau of the National Board of Fire Underwriters in one day noted approximately 100 reports of fires from this cause, out of a total of 2000 losses in the day's reports, and it estimates that small electrical devices are causing fires at the rate of 30,000 or more in the course of a year.

Most of these fires, it is claimed, are entirely preventable, and are due to carelessness on the part of the user. Various "safety" devices have been added by certain of the manufacturers, and among them are some that are fairly effective, but there is one absolute precaution which, the underwriters say, should be borne in mind at all times by every user, namely, that of shutting off the current when the device is not in use.

CENTRAL STATIONS STRUGGLE WITH FUEL PROBLEMS

Two Companies Negotiating for Desirable Coal Properties to Insure Sufficient Supply at Reasonable Cost

In order to improve existing fuel conditions the General Gas & Electric and Eastern Power & Light Companies have taken under advisement the policy of furnishing fuel to their subsidiary properties through the purchase or lease of some desirable coal properties. A careful investigation has been made of certain coal properties and options taken on them. The closing of these options will depend upon tests now under way at the plants of subsidiary companies and under actual operating conditions.

The subsidiaries of the General Gas & Electric and Eastern Power & Light Companies are now using 250,000 tons of coal per annum, and the demand is constantly on the increase. It is felt that with relatively steady load conditions on the combined utility properties, provision for storage at the mines and the present storage capacity at the several subsidiary plants it will be possible to operate the mines at a uniform output during the entire year, so that with selling expense eliminated, these utilities should secure coal at a very favorable rate after Sept. 1, 1917.

Commenting on the fuel situation W. S. Barstow, himself a well-known utility man and consulting engineer and head of the companies in question, said:

"One of the most important items of expense which a large public utility company is obliged to consider is its fuel cost. In very large properties with high load factors, the coal item is the greater part of the operating expense.

"Prior to the European war the price of coal was fairly uniform, from year to year and season to season, owing to the comparatively quiet business conditions and a favorable labor situation. There was, of course, a natural upward tendency in price, due to the steadily increasing cost of labor and other factors of general progress, but these increases were readily absorbed by the steady improvement in power-house efficiency. But with the starting up of munitions plants, the suddenly increased demands of the shipbuilding industry, increased freight transportation and the springing up of hundreds of new manufacturing enterprises there was

brought about a condition in the coal industry which is without parallel and which is likely to continue for an indefinite period. With the demand for coal doubling every four years, under fairly normal conditions, it does not seem likely that the price will return to the basis of two or three years ago, even though the war should prove of short duration. In fact, it is not probable that anything short of a serious industrial panic will ever again bring coal back to its former price level.

"Up to the middle of last year many public utility companies were able to purchase coal at the mines at from 70 to 90 cents per ton. They are now paying an average price, on yearly contracts, of $1.55 per ton at the mines, and at the present moment no contract for future delivery can be made for less than $2.50 per ton. Those companies which are buying in the open market—and many of them must get part of their supply thus, owing to delays in delivery on contract coal—are paying from $4.25 to $5 per ton at the mine.

"Of course, the price to manufacturers has increased proportionately. But the manufacturer, when he finds it too costly to make his own power, has the central station with its fixed rates to fall back upon. Many have already done this. Many others are signing contracts for power who, a few months ago, gave scant attention to electric drive."

MASSACHUSETTS UTILITY PRACTICES LOOKED INTO

Rate and Contract Publication, Meter Standardization and Service Supply Discussed Before Legislative Committee

Publication of all existing rates and contracts for electric service, the transfer of meter supervision to the sealer of weights and measures, and the enforcement of electrical supply beyond normal limits of distribution were advocated in two recent hearings before the committee on public lighting of the Massachusetts Legislature, opposition being voiced by the Massachusetts Electric Lighting Association and other representative central station interests. F. J. Southgate, Worcester, Mass., a former electrical contractor, appeared in behalf of the printing of all rates and contracts by central station and power companies, with the date of publication on all schedules, the forbidding of changing prices prior to their posting and the filing of complete copies with the Gas and Electric Light Commission. The speaker contended that discrimination has arisen through the granting of special rates to contractors for window display lighting.

Upon request of the committee, Chairman A. R. Weed of the Gas and Electric Light Commission said that the statutes require the electric companies to furnish such information as the board requires relative to rates in vogue, and that in 1912 the commission issued an order requiring the filing of all schedules and special contracts and all changes in rates. In 1916 the order was reissued, as it appeared that in one or two instances it was not being fully complied with. These data are open to the public upon request at the office of the commission, and in view of the rapid advance of the electrical industry and the frequent changes in rates that are not only necessary, but desirable and in the public interest, the commission has not felt it necessary to recommend legislation requiring the printing of all rates in force. The board can apply to the courts in case any company disregards its instructions. The elimination of special contracts is proceeding in due course. Everett W. Burdett, for the Massachusetts Electric Lighting Association, said that at the time of the consolidation of the Edison Electric Illuminating Company of Boston and the Boston Electric Light Company, about 1500 special contracts were in vogue. These have been eliminated as fast as possible, until to-day only seven or eight remain.

W. Rodman Peabody, for the Turners Falls Power & Electric Company, objected to the proposed legislation on the ground that scarcely any two contracts for hydroelectric power are the same in terms, on account of the differences in conditions prevailing among customers of such companies. These companies are required to file such contracts with the Gas and Electric Light Commission, and in case printing should be required the burden would be very severe. The speakers on behalf of the companies disclaimed any desire to suppress rates, but contended that present provisions for their publicity are sufficient.

METER STANDARDIZATION

Placing all electric meters under the supervision of the sealer of weights and measures was advocated by the Dorchester (Mass.) Board of Trade. J. W. Cowles, superintendent of the department of installations Boston Edison company, explained to the committee the care taken to insure accuracy in meter service, emphasizing the factory, laboratory and installation tests conducted by the Boston company. On Feb. 1 there were 106,700 meters in service on the Edison system and the company now makes 75,000 routine tests of meters annually, the period ranging from two to twenty-four months per meter, depending upon size and type. In case of complaint against a meter, the records of the billing and accounting department are checked, after which a special test is made of the meter in service and reports made to the billing department and customer as to the finding. The customer is charged nothing for this test, but is informed that if he is not satisfied the meter can be given a check test by the Gas and Electric Light Commission at a cost usually running between $1.50 and $5. In case the customer is correct, he does not have the meet this additional outlay. On the Edison system seventy-five technically trained men are constantly engaged in meter testing, and demand as well as integrating meters are tested regularly.

UNPROFITABLE SERVICE EXTENSIONS

One of the bills before the committee required the Boston Edison company to furnish service within ninety days upon written demand whenever six residential customers on any street or private way where wires may be laid, owning property within 1000 ft. (of the street), and within 1 mile of existing service. L. L. Elden, electrical superintendent of the company, outlined the method of handling extensions of doubtful profit. In such cases, where one customer desires service, he is asked to guarantee a return on the cost of extension spread over usually from three to five years. The energy consumed is credited against his guarantee, and if other customers are connected, all their payments for energy are credited against the first consumer's guarantee. Only five guarantees were asked for by the company in the past year in the entire Edison territory of 600 square miles. Mr. Elden said that in general underground distribution costs five or six times as much as overhead supply. The guarantee is based upon yielding a fair return upon the investment, including maintenance and depreciation. Thus, a 250-ft. extension costing, say, $185, would be expected to carry a guarantee of about $27 per year, while the same length of underground extension, costing perhaps $800, would demand a return of $120. Renewal of the poles every twelve years would be necessary, but generally inside of two or three years the territory develops sufficiently to extinguish the initial burdens of the remote customer.

Commission Rulings

Important Decisions of Various State Bodies Involving or Affecting Electric Light and Power Utility Operation and Practice.

Illinois Commission Takes Stand That Ultimate Use of Service Determines Rate, Not Apparatus.—In the case of Redmond versus East St. Louis Light & Power Company wherein reparation is asked for alleged overpayments on electric bills for service rendered to a moving-picture theater under a lighting rate instead of a power rate, the State Public Utilities Commission of Illinois takes a different position from that of the New York first district commission in Vandeau Amusement Company versus Edison Electric Illuminating Company of Brooklyn (1916-E. P. U. R. 1046), and follows somewhat the position of the Montana commission in Orpheum Theater versus Helena Light & Power Company (1917-A. P. U. R. 65).

The complainant's theater takes three classes of service from the respondent's mains, namely, general lighting, sign lighting, and spot-lighting for the moving-picture screen. To convert the electricity used for the moving-picture machine from alternating current to direct current, the complainant has installed a motor-generator set, which is metered on the alternating-current side, thereby throwing all losses upon the consumer. The complainant avers that this is a power service inasmuch as the motor-generator set is of itself a power device. The respondent avers that the use to which the moving-picture machine is put, lighting, should prevail as classification for the service.

The New York commission, in the Vandeau case, has held that this sort of service to moving-picture theaters is power. The Illinois commission holds that the ultimate use to which the service is put in reality determines the classification; and also holds that the service rendered the complainant's motion-picture machine approaches a power characteristic and should receive recognition as such in a properly classified rate.

In discussing classification of utility service, the commission says, in part:

"The question, therefore, may be narrowed down to one of whether the service in question is used for lighting purposes or for power purposes. Here again the obvious intent of the company in developing its schedule of rates and classifying the same must be considered, since these schedules return to the utility a certain net revenue, which, for the purpose of this proceeding, may be considered just and reasonable in amount. The reasons for making a different rate for lighting and power purposes are perhaps three in number. The first reason is because of differences in the customer's characteristics in utilizing the service, *i.e.*, the hours of use, the times of day and quantities used. The second reason is because of differences in the quality of service rendered by the company, due to the fact that voltage fluctuations for power service need not be confined within the limits required for adequate lighting service, and further due to the fact that the expense of maintaining the customer's installation may be dissimilar for the two classes of service. The third reason is because of differences which may exist in the value of the service to these classes of consumers, which takes cognizance of the costs at which the service might be replaced by other means and the relative advantages which such other means might possess for performing the desired functions.

"It must be appreciated that in developing rates to serve lighting consumers, and rates to serve power consumers, the characteristics and the character of service necessary on the average for each of these classes of consumers must be considered; that is, it is because the average lighting consumer and the average power consumer have different characteristics that the difference in the rates is permissible, and it would be obviously impracticable to compare the characteristics of an individual lighting consumer with the characteristics of an individual power consumer. Consequently, it would, therefore, be unfair to assume that a long-hour lighting user is entitled to power rates, since to give him such rates would destroy the average previously established for the lighting class of consumers, and in the case of a large consumer, might materially alter the characteristics of the class as a whole. It would appear that since the classification of rates is based upon these fundamental characteristics for the various classes of service, the manner by which the ultimate service is obtained or the intermediary which is used in obtaining it is not of great importance, provided the use of this intermediary does not materially affect the essential characteristics of the ultimate use of the service. An instance in which the use of the intermediary does materially influence these characteristics exists in the case of service rendered for charging storage batteries, since the conditions under which the batteries are ultimately used are in no way reflected in the conditions under which the utility service is used for charging the batteries.

"Power rates are not fixed because of the fact that power service is usually rendered to a specific piece of mechanical equipment called the motor, but are rather determined by the inherent characteristics which power applications have. Neither are lighting rates fixed by the fact that the electricity is purchased for application to the terminals of an apparatus for giving light, but are rather determined by the fact that the lighting consumers, as a class, have certain inherent characteristics in their use of the service, which go to determine the expense to the utility of furnishing the service."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public-utility companies.

Concurrent Negligence for Faulty Construction and Maintenance.—Where an injury from a collision is due both to a runaway horse and to the obstruction of a telegraph pole, both the runaway and the obstruction may be regarded as the proximate cause, but the runaway, though a proximate cause, will not relieve the telegraph company from liability, if the injury would not have resulted but for the negligent obstruction, it was held by the Court of Appeals of Kentucky (189 N. W. 707). Where a telegraph pole was out of line with the other poles, and was 4.5 ft. from the fence, and a foot from the traveled portion of the road, it was for the jury to say whether it was on or so close to the traveled way as to make it dangerous or unsafe for the traveling public.

Furnishing Safe Place to Work for Employees of Independent Contractor.—The Supreme Court of Vermont held in (99 A. 241) Richards vs. Consolidated Lighting Company that where the defendant arranged with a traction company to have such company remove its ashes as required, and the traction company engaged another to perform the work, a teamster of such third person carrying away the ashes, the defendant merely directing removal according to necessity, is not an employee of defendant for whose negligence it is liable. An owner does not owe to a person employed on his premises in the service of an independent contractor any duty to furnish a safe working place, yet as such employee is on the premises by invitation, the owner if retaining control must exercise reasonable and proper care to see that the premises are absolutely safe.

Compliance with Statute Not Evidence of Proper Construction.—While the laws prescribe certain rules for the construction of electric lines, compliance with the statute is not evidence of proper construction, it was held by the Supreme Court of Washington in Haas vs. Washington Water Power Company (160 P. 954) except in those particulars covered by the statute, so that evidence that by the use of lightning arresters the defendant electric power company's wires would have been so grounded as to prevent excess of current from entering appellant's premises on service wires is admissible. Where it appeared that the defendant took the only practical method of discovering the cause of trouble on its line, and there was a conflict in the testimony of its witnesses as to the amount of current turned on to make the test, whether the defendant was guilty of negligent operation was held for the jury.

Electrical Goods in Cuba.—A report on "Electrical Goods in Cuba," by Philip S. Smith, special agent of the government, has just been published by the Bureau of Foreign and Domestic Commerce. A copy of this publication, known as special agents' series No. 128, will be sent on receipt of 5 cents.

Cincinnati Company Makes Refund.—On account of a compromise reached between the city of Cincinnati and the Union Gas & Electric Company on the Cincinnati electric rate, the company is refunding to consumers about $30,000, representing the difference between the old rate and the ordinance rate over which the controversy arose.

Income from Electric Cooking.—The sale of energy by the Washington Water Power Company of Spokane, Wash., for cooking has made a notable advance during the past year, it was stated in the company's annual report for 1916. The present annual income from this source is in excess of $50,000, and it is expected that this will be doubled during 1917.

New Plant for Port Arthur, Tex.—According to an official announcement, the Port Arthur Light & Power Company will erect a new power generating station shortly at an approximate cost of $400,000. The plant, which will be built near the existing station, will be constructed on the unit plan, provision to be made for future extensions up to an ultimate capacity of 28,000 kw.

"Here We Are."—The first issue of a new company paper entitled "Here We Are" has been issued for distribution among the employees, officers and owners of the Georgia Railway & Power Company, Georgia Railway & Electric Company, Atlanta Gas Light Company, Atlanta Northern Railway Company, Suburban Gas & Electric Company of Decatur, Ga., and Carrollton (Ga.) Electric Company.

1917 New York City Electric Vehicle Handbook Now Ready.—The handbook showing the locations of all electric automobile charging stations in New York City and vicinity, published annually by the New York Electric Vehicle Association, together with route maps, is now ready for distribution. It will be sent free to any one requesting it. The 1917 edition has several features—information as to the maximum amperage and voltage available at different charging stations; the house service may be obtained, and prices charged for boosting. Besides this there are clear, concise instructions as to boosting, and the possibilities it gives to obtain additional mileage in short order. The maps in the pamphlet show a tremendous increase in the number of charging stations recently established within the hundred miles centering around New York City, and an increase also in the facilities of the stations already in existence to meet the constantly greater demands upon them. New York City's map, including the Bronx, is dotted with the little red squares that mean charging stations, while many of them are also fitted for garage service.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Tax on Energy Sold Outside City by Municipal Plant.—The Tacoma, Wash., city council has adopted a resolution favoring a gross income tax on city light plants for the sale of power outside city limits. This resolution seeks to eliminate one of the strongest arguments of the opponents to home rule legislation, allowing municipally owned utilities to sell water, light and power, or extend street car lines outside city limits. One of the strongest arguments against the bill is that city owned plants are not subject to taxation.

Lehigh Valley May Electrify Part of Main Road.—The Lehigh Valley Railroad is investigating the feasibility of electric operation of its main line, from Jersey City to Wilkes-Barre, about 176 miles, and the Mahanoy and Hazleton division, from Penn Haven Junction to Mount Carmel, about 52 miles. It is planned to employ the generating plants of the Lehigh Coal & Navigation Company at Harwood and Hauto, with the installation of new power units and necessary transmission system. The improvement is estimated to cost about $11,000,000.

Movement for Increased Adoption of Metric System Gaining Headway.—During the sixty-ninth meeting of the American Association for the Advancement of Science, in New York during Christmas week, 1916, a conference was held, designated the "metric conference," at which were present representatives of national business organizations, the United States Department of Commerce, and men prominent in engineering and educational work. The object of this conference was to discuss the Pan-American use of the metric system. Its outcome was the formation of a permanent organization to be known as the American Metric Association, to further the adoption of the international meter, gram and liter, which have been legalized in the United States since 1886. The officers of the association are as follows: President, George F. Kunz; first vice-president, Wm. Jay Schieffelin; second vice-president, E. P. Albrecht; third vice-president, O. E. Stanley; treasurer, Arthur P. Williams; secretary, Howard Richards, Jr., 156 Fifth Avenue, New York. The executive committee consists of H. V. Army, Fred. R. Drake, A. E. Kennelly, S. W. Stratton and W. P. Wilson. The association now maintains an office at 156 Fifth Avenue, New York, and is especially desirous of receiving catalogs of manufacturers who use the metric system for domestic or export purposes.

Public Utility Monopoly Bill Before West Virginia Legislature.—What is known as the Johnson bill, designed to prevent the duplication of public utilities, is now before the legislature of West Virginia. It provides that no permit shall be granted by the State Public Service Commission to a corporation to furnish telephone service in any municipality, or to furnish heat, light, water, electricity, transportation or other like service, when a similar service is already being furnished by another corporation, unless the commission finds that the public service will be promoted thereby. The bill has some bitter enemies in both branches of the Legislature, but apparently it is favored by a majority of the members of the House.

Bill to License Pennsylvania Electricians.—Among the bills introduced in the Pennsylvania Legislature was one which provides for the examination, licensing and registration of electricians in cities of the second and third class. The act defines the master and journeymen electricians. The bill provides that sixty days after the measure becomes a law it shall be unlawful for any master electrician or journeyman to carry on or work at the business of electrical construction. Application for a license must be made to the head of the electrical bureau. Licenses shall issue upon the approval of a board of examiners, who are to be appointed by the mayor and consist of the chief city electrical inspector, one inspector from the National Board of Fire Underwriters and two competent electricians of at least nine years' experience in building construction wiring, and not connected with the city government, who shall examine all applicants for license under the provisions of this act. Master electricians shall pay $5 and journeymen $1 as an examination fee.

A Bill to Create Water Power Development Commission for New York State.—Bill No. 698 has been introduced into the New York State Assembly and referred to the committee on ways and means, creating a water power development commission to consist of the State engineer and surveyer, the conservation commissioner, the attorney-general and the superintendent of public works, for the purpose of investigating the character, value and extent of location of surplus waters of the State available for power or other electrical developments. The sum of $40,000 is appropriated for expenses and salaries. The members of the commission shall serve without additional compensation, and shall report to the Legislature Feb. 1, 1918. It is expected that the measure will have the support of the majority party at Albany, it having been introduced in the Senate by Senator Sage, chairman of the Finance Committee. There has also been presented a bill amending Sec. 86 of the transportation corporations law, by prohibiting the charging or collecting of rent on electric meters either directly or indirectly by public utilities.

Dallas Club Discusses Storage Batteries.—An educational talk by G. L. Barrett, general manager, Willard Storage Battery Company of Texas, was given before the Dallas Electric Club and Jovian League on Feb. 5 on the subject of "Storage Batteries."

Street Lighting Specifications.—At a joint meeting of the Pittsburgh Section of the American Institute of Electrical Engineers and of the Illuminating Engineering Society on Feb. 13, W. E. Reed, consulting engineer, presented a paper on "Street Lighting Specifications."

Ohio Electric Light Association Meeting.—Arrangements are being made with the Cedar Point Resort Company to hold the annual convention at the Breakers Hotel during the week beginning July 16. It is the intention of the association to hold a five-day convention beginning Monday afternoon, July 16. The calendar of standing committee meetings for the remainder of the fiscal year follows: New-business cooperations, Dayton, March 14, and Youngstown, May 16; station operating, Cincinnati, April 24; transmission and distribution, Toledo, Feb. 21, and Canton, April 11; meter, Toledo, March 23.

Mid-Winter Meeting of Ohio Station Operating Committee.—The Ohio Electric Light Association station operating committee held its mid-winter meeting at the Hotel Ohio in Youngstown on Feb. 14. The following program was scheduled for the morning: "Selecting, Educating and Handling Power-House Labor," by H. W. Bromley of Youngstown; "Safety First in Power Plants," by Herman George, Youngstown; "Effect of Steel Mill Operating on the Method of Operating Stations," by Philip H. Marble, Youngstown. After lunch there were two inspection trips, one to the Lowellville plant of the Mahoning & Shenango Railway & Light Company, and the other to the Youngstown Sheet & Tube Company.

Kansas City Jovians in Civic Work.—The Jovian League of Kansas City, at its recent semi-monthly meeting, heard a report on the work of the Signal Corps from Kansas City at the border, by Ruby D. Garrett, captain of the company. Oliver Wroughton, a director of the Anti-Motor Thief Association, talked on the marked gain in co-operative activity among the civic bodies of Kansas City, mentioning the part taken by the Jovian League, and asked the League to appoint a representative on the central committee of the association, which is radically reducing the number of thefts of motor cars in Kansas City. The executive committee will appoint the representative. President P. L. Lewis announced the appointment of a committee to serve with a board the mayor is forming, to study the question of light and power supply for Kansas City, Mo. He named A. P. Denton of the Denton Engineering & Construction Company to act on the board, and E. L. Foutch of the B-R Electric & Telephone Manufacturing Company and R. D. Obermeyer of the General Electric Company to assist in preparation of data.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Meeting of Connecticut Electrical Men.—The winter dinner of the Connecticut Get-Together Club of the National Electric Light Association will be held at the Hotel Bond, Hartford, on Feb. 19, at 6.30 p. m.

High Frequency Discharge.—E. E. F. Creighton, General Electric Company, delivered an address on Jan. 19 before the Detroit Engineering Society on the subject, "High Frequency Discharge." The lecture was accompanied by stereoptican views, demonstrations and experiments.

Radio Club of America.—At the Feb. 16 meeting of the club, Prof. L. A. Hazeltine of Stevens Institute of Technology presented a paper entitled, "Dielectric Losses and Capacity of Multilayer Coils." Following the presentation of the paper, discussion was opened on both this paper and on Professor Morecroft's paper, entitled, "Inductance and Capacity Phenomena," which was presented at the January meeting.

Northwest Electric Light & Power Convention Plans.—The program committee of the Northwest Electric Light & Power Association, of which M. C. Osborn of the Washington Water Power Company is chairman, at a meeting on Jan. 26 made an initial layout of the program of the annual convention to be held in Spokane, Wash., on Sept. 12, 13, 14 and 15 of this year. In the preparation of the program, it was decided by the committee that all papers should be of a composite nature, with an editor-chairman for each, and assistants selected from the best talent that can be secured from the various member companies, on the subjects to be discussed. To prevent duplication of ideas, the editor-chairman of each paper will present for the association's deliberations the ideas of the various members of his committee in one paper, the main idea being to eliminate all theories and confine themselves to the results obtained in practice. The Washington Association of Electrical Contractors and Dealers, which anticipates an attendance of 100, will hold its annual convention at the same time and place, namely, the Davenport Hotel, and will have a joint meeting with the Northwest association at the opening session, on Sept. 12 in the morning, at which time the usual address of welcome by the Mayor, a response, an address by the president of the association, and the reports of the committees will be presented and a paper by J. C. Ralston, a member of the American Society of Civil Engineers, entitled, "Aphorisms." The following program has been laid out: Wednesday, Sept. 12, in the afternoon, a paper on "Practical Central Station Salesmanship," the following committee, of which Lewis A. McArthur, Pacific Power & Light Company, is editor-chairman: George Bowen, Northwestern Electric Company; S. A. Hoag, Puget Sound Traction, Light & Power Company; H. W. Lines, Portland Railway, Light & Power Company; Lewis A. Lewis, Washington Water Power Company. Thursday morning, a paper on "How the Engineer Can Assist the Commercial Department," by the following committee, of which George E. Quinlan of the Puget Sound Traction, Light & Power Company is editor-chairman: E. H. LeTourneau, Portland Railway, Light & Power Company; A. S. Hall, Pacific Power & Light Company; D. F. Henderson, Washington Water Power Company; L. T. Merwin, Northwestern Electric Company. Thursday afternoon, a paper entitled, "Co-operation in Modern Home and Apartment House Wiring Practice," by the following committee, of which A. C. McMicken, Portland Railway, Light & Power Company, is editor-chairman: H. H. Scofield, Pacific Power & Light Company; J. R. King, Puget Sound Traction, Light & Power Company; F. O. Broili, Northwestern Electric Company; Foster Russell, Washington Water Power Company. Both sessions on Friday will be devoted to the report of the range committee. W. R. Putname, Utah Power & Light Company, Salt Lake City, Utah, will act as chairman of the committee on which will act S. M. Kennedy of the Southern California Edison Company and S. V. Walton of the Pacific Gas & Electric Company, and others who will be announced later by the chairman. In connection with the range committee report, a paper will be read by H. B. Peirce of the Washington Water Power Company, Spokane, Wash., on "Busbar Diversity of Ranges," compiled from data gathered from the study of residential feeders and other sources; also a paper by B. L. Steele, professor of physics at the Washington State College, entitled, "Comparative Tests of Coal, Kerosene and Electricity for Cooking," (a) "Cost of Typical Meal for Five Persons by Coal and by Electricity; (b) Cost of Cooking for Five Persons One Week, by Coal with Water-Back Attachment and Without Water-Back Attachment and with Electricity; (c) Efficiency Tests on Coal Range, Kerosene Burners and Various Electric Ranges." The "Experience and Wrinkles" paper read at the convention two years ago in Spokane, was thought to be of a great deal of value to the association, and will be revived this year, edited by Lewis A. Lewis of the Washington Water Power Company . These wrinkles are any devices, short cuts, methods or experiences which have been worked out and used to advantage in carrying out one's business. Mr. Osborn has stated that this is intended to be a convention, the program of which is made up by all the membership of the association.

R. E. LEE

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Rufus E. Lee, who for many years has been general manager, secretary and treasurer of the Lee Light & Power Company of Clarinda, Iowa, has tendered his resignation to become effective March 1. Mr. Lee was connected with the company and its predecessors in the capacity of general manager since the business was started in 1902. The company at that time had less than 100 customers, and a plant of about 100-kw. rating. At the present time the system serves 2200 consumers in ten different municipalities from a plant rated at 1500 kw. The Lee Light & Power Company also operates a central steam-heating system, manufactures ice, and does a general cold-storage business. During his fifteen years in the central station business in Iowa, Mr. Lee has been a very active member of the Iowa Electrical Association, and during 1914 held the office of president of that organization. After March 1 he will reside at Cedar Rapids, Iowa, and will devote his attention to the operation of a large artificial ice plant in that city.

E. K. Sheble, who has been secretary of the Washington Construction Company, of Seattle, Wash., has resigned to join the organization of the Stone & Webster Engineering Corporation of Boston, Mass., as superintendent of construction. Mr. Sheble was connected with the Washington Construction Company for seven years, and was also connected with the engineering department of the city of Seattle for three years.

W. L. Goodwin, who was formerly Pacific Coast manager of the Pacific States Electric Company, has accepted a position with the General Electric Company at Schenectady, N. Y. At the farewell dinner tendered to Mr. Goodwin by prominent San Francisco electrical men the guest of the evening was presented with a handsomely engraved gold watch by the members of the Socket Club. At the annual banquet of the Pacific Coast Jobbers' Association at Del Monte, Cal., on Jan. 13, Mr. Goodwin's work in the interests of Pacific Coast business was also highly commended.

S. F. Bastow, who for the last four years has been joint manager of Bruce Peebles & Company, Ltd., Edinburgh, Scotland, has accepted the position of chief engineer to British Dyes, Ltd. Mr. Bastow's headquarters will be at Huddersfield.

J. C. Kirkpatrick, the president-elect of the Northern White Cedar Association, has for many years been one of the leading figures in the cedar-pole industry. He became identified with the pole trade about twenty-five years ago as general manager of the Pittsburgh and Lake Superior Iron Company when this company began cutting poles from its lands in the Northwest. In 1907, when the National Pole Company was formed to take over the cedar department of the Pittsburgh and Lake Superior Iron Company, Mr. Kirkpatrick assumed the presidency of both companies. He is also president of the American Cross Arm Company and is interested in other corporations.

P. H. PALMER

Phil H. Palmer, who was recently appointed general superintendent of the Indiana Railways & Light Company, with headquarters at Kokomo, Ind., has been connected with the Kokomo electric lighting and interurban property for the last thirteen years in various capacities, beginning as electrical engineer and superintendent of the lighting and power department for the predecessor company—the Kokomo, Marion & Western Traction Company. Prior to this, Mr. Palmer was for five years manager of the Bloomfield (Iowa) Electric Light & Water Company. Mr. Palmer succeeds T. C. McReynolds, former vice-president and general manager of the Kokomo property, who has removed to Arizona on account of his health.

A. S. HALL

Albert S. Hall has resigned his position as manager of the Hood River Gas & Electric Company of Hood River, Ore., to take up work with the Pacific Power & Light Company in the capacity of district manager. In his new duties Mr. Hall will make his headquarters at Pasco and Kennewick, Wash.

H. T. Glover, who was formerly sales manager of the Esterline Company, Indianapolis, Ind., has resigned. Mr. Glover's present address is 1841 Talbott Avenue, Indianapolis, Ind.

John H. Bunting, who for the last four years has been joint manager of Bruce Peebles & Company, Ltd., Edinburgh, Scotland, has been appointed general manager of the company.

E. J. Mehren, editor of the *Engineering Record*, has been elected first vice-president of the McGraw Publishing Company, Inc., publisher of the ELECTRICAL WORLD, succeeding Hugh M. Wilson, resigned. He will continue as editor of the *Engineering Record*, devoting to each position half of his time.

L. S. Small, formerly manager for the Texas Power & Light Company at Tyler, Tex., has become connected with the Commonwealth Light & Power Company as general manager of a group of twenty-two properties in the Central West, of which he will take charge about May 1. Meanwhile Mr. Small is doing engineering work for the General Engineering & Management Corporation in the South.

Obituary

James Terry, president of the Terry Steam Turbine Company of Hartford, Conn., died on Feb. 3, at the age of 44 years. Mr. Terry was born in Hartford and was graduated from Sheffield Scientific School of Yale University in 1895. He was the son of the late E. C. Terry, the inventor of the turbine, who founded the present company in 1906. James Terry, upon the death of his father about nine years ago, followed up the commercial development of the company, bringing it to its present successful stage.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

VOLUME OF INCOMING ORDERS FOR SUPPLIES MAINTAINED

Diplomatic Break with Germany and Consequent Probability of War Practically Unfelt in the Electrical Manufacturing Industry

No traces of that panicky condition which generally follows closely on the heels of any announcement of a break in diplomatic relations with first-class foreign powers were evident in the electrical manufacturing industry since diplomatic relations with Germany have been discontinued. Manufacturers of practically every kind of electrical equipment and allied apparatus were almost unanimous in stating that the volume of incoming orders had shown practically no shrinkage since the President's last note to Germany. There have been cases, however, it is known, in which, coincident with the President's message to Congress announcing his decision, incoming orders have dwindled practically to zero. However, in view of the fact that so many concerns have felt no change, it is not improbable that any changes occurring may be due to other than war causes and in which the cessation of incoming orders may be only of a temporary character.

Ever since Germany first publicly made her offer of peace, industrial concerns in this country have been in a panicky condition. Peace, it was realized, would bring about a falling market, in which the losses would be proportionate to the rapidity of decline. For that reason, buyers have been made to place long-time contracts. Sufficient time has elapsed, however, since that peace proposal occurred, for manufacturers to prepare, and it seems quite probable, in view of present circumstances, that any conditions incidental to any act of this nation affecting its international standing have been very largely discounted.

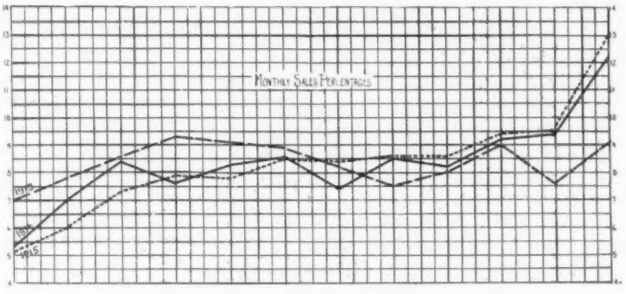
It is also doubtful if the people of the United States expect any such calamity to occur, if war is declared, as is now being enacted in Europe. In many minds, the declaration of war means another and greater industrial spurt. In that event, electrical buying would undoubtedly be very much greater.

1916 AS A JOBBING YEAR IN ELECTRIC SUPPLIES

Monthly Variations in Sales Compared with 1915 and with 1913 Show Little Resemblance to Conditions of Normal Activity

Above is presented a diagram showing the monthly variations in jobbing sales of electric supplies for 1913, 1915 and 1916. The points on these curves represent the percentage of the total year's sales made in each particular month. These three curves were selected in order to compare conditions existing during the pressure of an unusual volume of business with that of a normal year, 1913. In 1913 it will be noted the year opened up small, increasing to the spring peak in April, when it dropped off during the summer to a low point in August, and then increased again up to October, with a falling off in November and another gain in December. This is considered a normal curve. Here the spring building finds its reflection in the curve. There is always a great amount of building, particularly of outdoor construction, that begins in the spring, after the frost is out of the ground. There is also the annual drive for house-wiring prospects. These sales keep up pretty much till the hot weather sets in, when there is a decided drop. Practically all purchases have been made beforehand for any summer construction work, and, furthermore, the work is generally small owing to the great heat. Construction work becomes more active in the fall, and this is also reflected in the curve.

In 1915, however, it will be noticed the curve is generally one of ascending proportions. It will be remembered that the year 1915 opened after a half year of war, with industry practically at a standstill. There was little or no buying, money was scarce, and business therefore slack. Gradually, however, business worked up to the spring peak, but instead of following normal conditions the curve continued to keep upward as buying began to increase with the influx of war orders. From that time on to the end of



MONTHLY JOBBING SALES PERCENTAGES

the year business in electrical supplies became very brisk, particularly in the months of September, October, November and December, when the demand for all kinds of electrical machinery and supplies became acute.

The past year, which is the largest year ever experienced in the electrical industry, opened as the others with a small percentage, increasing to a spring peak in March, rather than April. This condition, however, it is probably true, was brought about by a further buying ahead than in previous years, in order to be assured of a satisfactory delivery. In April the sales dropped off, but the gains again increased to a peak in June. July was smaller, and August still larger, and from then on to the end of the year there was a gradually increasing curve, to an almost as large a percentage in December, 1916, as December, 1915.

It is thus noticed that the 1916 curve bears but little resemblance to the 1913 curve. In 1913 the sales followed the regular seasonal variations. In 1916, however, such was not the case. In 1916 frequently an anticipated rise in price caused buyers to flock into the market in order to buy on the rising market.

Since the accompanying curves depict national conditions, local jobbers, in making comparisons with their own curves, must take into consideration their geographic position. Thus Southern jobbers would find the spring peak coming earlier, while some of the Northern jobbers might find it coming later.

POLES PURCHASED DURING 1915

Telephone and Telegraph Companies Lead with Requirements of 1,680,880, Followed by Electric Railways, Light and Power Companies with Requirements of 1,430,122

Statistics of the number of poles purchased during 1915 in the United States by telephone and telegraph companies, steam and electric railroads, and electric light, heat and power companies have been compiled by the Forest Service through its office of industrial investigation. It is estimated that the figures given in the accompanying tables

represent between 90 and 95 per cent of the poles purchased.

Of a total of 4,077,964 poles purchased in 1915, as will be seen from Table I, 2,521,769, or 61 per cent, were cedar. The other woods in order of volume of sales were chestnut, pine, oak and cypress. Data for the years 1912, 1913 and 1914 have been omitted because statistics are not available. Compared with 1911, the last year for which statistics were available, 1915 sales represent an increase of 659,944 poles, or 16 per cent. The number of poles sold in 1915 is the largest reported in any single year.

The annual demand for poles, which now exceeds 4,000,000, the report states, is supplied principally from three different regions of the United States. The northern white-cedar region of the Lake States, the chestnut region of the

TABLE I—POLES PURCHASED IN 1915, AND FROM 1908 TO 1911, CLASSIFIED BY KIND OF WOOD

Kind of Wood	1915	1911	1910	1909	1908
All kinds	4,077,964	3,418,020	3,870,694	3,738,740	3,249,154
Cedar	2,521,769	2,100,144	2,431,567	2,439,825	2,200,139
Chestnut	651,643	693,489	677,517	608,066	516,049
Pine	546,233	161,690	184,677	179,586	116,749
Oak	199,442	199,590	265,290	236,842	160,702
Cypress	67,644	72,995	75,459	77,677	90,579
All other	91,233	190,112	236,184	196,744	164,936

Eastern portion of the country, and the Western red-cedar region of the Northwest, which includes Idaho, Oregon and Washington.

Most of the cedar poles purchased were the Northern white variety, which were purchased largely by telephone and telegraph companies and steam railroads. Electric railways, light and power companies, however, it was noted, purchased more of Western red than any other type of pole. These companies also had a large demand for pine poles.

Most of the pine reported was that commonly known as Southern yellow pine, and includes longleaf, shortleaf and loblolly. Western yellow pine was also reported in small quantities. Oak poles were purchased in practically the same manner as in 1911, while cypress poles showed a decrease. The use of cypress as a pole timber seems to be falling off each year. Cedar, chestnut and pine, together, formed more than 91 per cent of all poles reported purchased. The minor species reported were redwood, spruce, tamarack and osage orange. All of these, however, were reported in small quantities.

In Table II there is shown by years the number of poles purchased according to the class of purchaser and kind of wood. Telephone and telegraph companies were the principal purchasers, reporting more than 44 per cent of the total number of poles purchased. Electric railways and

TABLE II—POLES PURCHASED IN 1915, CLASSIFIED BY KIND OF WOOD AND CLASS OF PURCHASER

Kind of Wood	Total	Telephone and Telegraph Companies	Electric Railways, Light and Power Companies	Steam Railroads
All kinds	4,077,964	1,680,880	1,430,122	966,962
Northern white cedar	1,747,210	1,029,219	239,864	478,127
Chestnut	651,643	336,496	275,304	39,843
Western red cedar	567,770	105,590	422,312	39,868
Pine	546,233	69,787	388,210	88,236
White oak	177,799	34,644	13,110	130,045
Red cedar	117,545	21,386	8,424	87,735
Southern white cedar	89,244	16,661	14,686	57,897
Cypress	67,644	24,162	18,174	25,308
Red oak	21,643	6,912	13,001	1,730
All other	91,233	36,023	37,037	18,173

light and power companies purchased about 35 per cent of the total, while steam railroads purchased 21 per cent. A decrease of 721,844 poles, or 30 per cent, was reported by the telegraph and telephone companies, as compared with the number purchased by these companies in 1911, while the electric railways, light and power companies reported an increase of 642,473 poles, or 44 per cent. The steam railroads also reported an increase.

In Table III is shown the number of poles purchased, classified according to lengths and kind of wood. Poles are usually purchased in the round form, although occasionally a purchaser reported several species being sawed. However, these were of minor importance, and were either redwood or Western pine. The figures in the table have been divided into classes differing in length by 10 ft. Of the total number purchased, 2,768,135, or 67 per cent, were under 30 ft. Poles of these lengths are commonly used by telephone and telegraph companies. The poles under 20 ft. in length were reported chiefly by the rural telephone companies. Among the prominent woods reported under this classification were Northern white cedar, pine, and white oak. The number of poles ranging from 30 to 50 ft. in length aggregated about 30 per cent of the total, while those exceeding 50 ft. in length represent but a small proportion.

TABLE III—POLES PURCHASED IN 1915, CLASSIFIED BY LENGTH AND KIND OF WOOD

Kind of Wood	Total	Less Than 20 Ft.	20 to 29 Ft.	30 to 39 Ft.	40 to 49 Ft.	50 Ft. or More
All kinds	4,077,964	1,236,694	1,531,441	980,091	256,236	73,502
Northern white cedar	1,747,210	540,565	755,311	373,874	67,358	10,102
Chestnut	651,642	23,992	255,951	295,717	63,676	12,307
Western red cedar	567,770	17,874	314,010	139,041	71,608	25,237
Pine	546,233	373,688	69,931	65,004	23,914	13,696
White oak	177,799	120,393	33,550	16,120	5,998	1,738
Red cedar	117,545	94,997	14,870	5,624	1,541	513
Southern white cedar	89,244	4,414	13,282	49,264	15,734	6,550
Cypress	67,644	13,048	22,211	26,316	4,542	1,527
Red oak	21,643	3,737	16,341	1,280	139	146
All other	91,233	43,986	35,984	7,851	1,726	1,686

All of the leading woods covered by the table contributed poles of all lengths, although red oak contributed but a small per cent of the larger poles. More than half of the white-oak and pine poles were under 20 ft. in length.

In comparing the 1911 purchase of poles with the 1915 purchase, an increase of 832,966 poles under 20 ft. in length was reported, while the number between 20 ft. and 30 ft. showed a decrease of 330,375. The total number of poles purchased in the other lengths did not vary greatly from the 1911 figures, slight increases in all being reported for 1915.

COPPER MARKET QUIET

Few Sales of Large Blocks During Past Week at Prevailing High Prices

A few sales of 1,000,000-lb. lots of copper and over were reported during the past week at the prevailing high prices. There was no excitement, however, and the market continued its quiet tone. Prices are up 0.5 per cent from last week. There are some inquiries for first-half copper, but there is little or no activity in second-half copper.

There is a surplus of production over contracts for the second half year. Now, however, that the federal government is beginning to make preparations for war, should it arise, there is every indication that the surplus now seen will shortly be covered.

Under these conditions, there can hardly be any expectation of lower prices during the current year.

Quotations on Tuesday last for electrolytic were as follows: February, 34.5 cents; March, 34 cents; second quarter, 33 cents; third quarter, 30.5 cents; and fourth quarter, 29.5 cents.

NEW YORK METAL MARKET PRICES

	Feb. 6 Selling Prices Bid	Asked	Feb. 13 Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	136 0 0		138 0 0	
Prime Lake	32.00	to 33.00†	33.00	to 34.00†
Electrolytic	33.50	to 34.50†	34.00	to 35.00†
Casting	29.50	to 30.00†	30.50	to 31.50†
Copper wire base	39.75	to 40.75†	40.50	to 41.50†
Lead	8.00		8.50	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	21.00		21.00	
Spelter, spot	10.17½	to 10.42½†	10.42½	to 10.67½†
Tin, straits	55.00†		53.25†	
Aluminum, 98 to 99 per cent.	51.00	to 53.00†	51.00	to 53.00†

OLD METALS

Heavy copper and wire	25.50	to 26.00†	26.00	to 27.00†
Brass, heavy	15.00	to 15.50†	15.50	to 16.00†
Brass, light	11.50	to 12.00†	12.00	to 13.00†
Lead, heavy	7.25	to 7.37½†	7.50	to 7.75†
Zinc, scrap	7.50	to 7.75†	7.50	to 7.75†

COPPER EXPORTS

Total tons to Feb. 13 11,719

†Nominal.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Chemically Treated Sandstone for Switchboard Service

A natural sandstone which has been chemically treated to toughen it and make it impervious to moisture is a recent product of the Stone Base and Panel Company, 315 Schultz Building, Columbus, Ohio. It is claimed that this stone can be used wherever marble has been employed heretofore, being equal to marble in its resistance. It is said to have a fine texture, and is free from dry seams, metallic veins and other imperfections. Attention is also called to the fact that this stone is tough and strong and has a certain amount of flexibility which slate and marble do not have. This stone, which is made up in any size and thickness desired, with an even texture throughout, has been approved by the Underwriters' Laboratories.

Telescopic Crosshead Pin and Eccentric Oilers

The Richardson-Phenix Company of Milwaukee, Wis., has recently brought out a complete line of telescopic crosshead pin and eccentric oilers which contain many new features. In Fig. 1 the telescopic oiler is shown supported by means of a crossbar, *B*, and an upright, *A*, which is screwed directly into

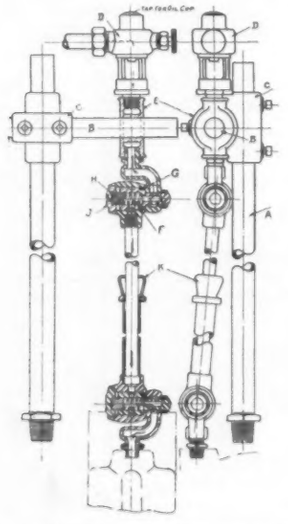


FIG. 1—GENERAL ARRANGEMENT OF TELESCOPIC OILER AND SUPPORTING STAND

the engine frame. These two bars pass through fitting *C* which provides for both horizontal and vertical adjustment. The oil is fed through the Richardson sight feed *D* connected directly to the oiling system, or when so desired the oil can be fed from an oil cup mounted on top.

The path taken by the oil after leaving the sight feed is indicated by arrows. It passes down through the go-round *E*, the top knuckle joint, down through the telescopic tubes, then through the bottom knuckle joint and then into the bearing.

Details of construction of the knuckle joint are shown in Fig. 2. An important feature is the method of keeping the joints oil-tight. A spiral steel piano wire spring (5) holds the two halves of the joint against the composition washer (8), which is inserted between the stationary parts (1) and (2) and the oscillating parts (3), (6) and (7). The outer end of the spiral spring bears against a hardened steel pin (6) in the cap (7). The joint is so designed that

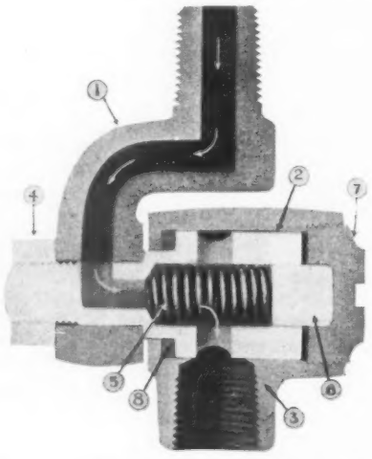


FIG. 2—DETAILS OF CONSTRUCTION OF KNUCKLE JOINT

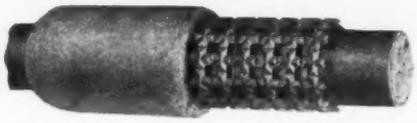
the bearing points of the spring are inside of the fittings, where they are protected from dust and grit and where they are continually flooded with oil, reducing friction and preventing wear. The spring automatically takes up for any wear which might occur, it is claimed, keeping the joint tight after years of service.

The knuckle joint is a bronze casting. All parts are machined to jigs or on automatic machines, insuring complete interchangeability. The telescopic tubes are annealed steel tubing. The upright *A* is 1 1/16 in. and the cross bar *B* ⅞ in. solid bars of cold rolled steel, accurately fitted to the openings in the fitting *C*.

A feature of the R-P telescopic oiler to which attention is called is that there are no outside springs or projecting parts which are unsightly, dangerous, and liable to catch in the waste used by the operator when wiping around the engine.

Cable Covering

A brick lath covering for electric cables in manholes as protection against fire, as well as against short circuits, is being made by the Composite Metal



METHOD OF APPLYING BRICK LATH TO PROTECT MANHOLE CABLES

Lath Company, 128 Broadway, New York City. This covering is made of a mesh of steel wire upon which ordinary brick or terra cotta has been baked in such a way as practically to inclose the wire. It comes in large sheets 40 in. wide and 16 ft. long, which can be cut into strips about 3 in. wide and wound spirally about the cable to be protected. A mixture of two parts sand to one part Portland cement is then wiped on by hand to a thickness of about ⅝ in. It is said that this covering can be easily applied in confined spaces such as are frequently found in manholes.

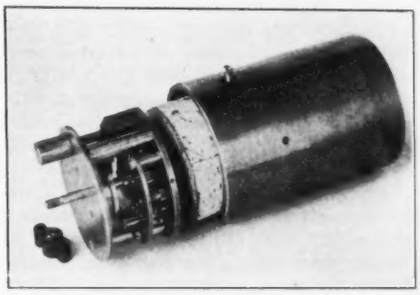
Combination Switch and Rheostat

An improved type of a liquid resistance device which is entirely automatic applies current gradually to a lamp or motor and requires the same attention as a snap or knife switch has been developed by W. B. Crossland of Merchantville, N. J.

The switch is composed of a wall box and flush plate, a cylinder which incases the container for the liquid and a time device carrying a cut-in for retarding the movement of the container to a predetermined time. The liquid container is divided by a perforated partition through the center. One compartment contains the electrodes which are tapered, and so arranged that the encroachment of the liquid on and around them lowers the resistance allowing the current to build up to normal, at which time the cut-in short-circuits the liquid. On the other hand, as the liquid leaves the compartment, diminishing and draining it from the electrodes, the resistance is increased until the circuit is opened. Then a cut-out performs its function by cutting the container entirely from the circuit.

To open the circuit the container is turned over a half turn with the electrode compartment up when the liquid

flows off, opening the circuit. The movement that turns the electrode compartment to the top and opens the circuit keeps the spring in the time device to a high tension, and also operates the cut-out.



VIEW SHOWING PARTS OF COMBINATION SWITCH AND RHEOSTAT

To close the circuit, the time device is released by a push button and propelled by the spring, the device moves the container back one-half turn, placing the electrode compartment below. This immerses the electrode, relieving the resistance until the current is brought to normal as the time device firmly places the cut-out in its socket and short-circuits the liquid.

By the gradual application of the current to the lamp, it eliminates the over shoot, shock and sudden expansion relative to the instantaneous heating effect by carrying the lamp over its most trying ordeal and keeping the filament as far as possible from the fusing point the longest possible service is insured, defects in the filament will not materialize, and the burning hours of lamps containing filament from the same mixture will be consistent. When used in connection with motors it is impossible to start the motor other than slowly and evenly.

Oil Lamp Converter

The Plume & Atwood Manufacturing Company of Waterbury, Conn., is marketing a device designed to assist in the easy conversion of an oil lamp into an electric lamp. As shown in the

OIL LAMP CONVERTER WITH PULL CHAIN SOCKET

accompanying illustration, the device consists of a threaded collar which will fit into the burner socket of a No. 3 oil lamp, a standard electric lamp socket equipped with either a pull chain or a key, and an ornamental brass holder. Six feet of silk-covered cord and a separable attachment plug is also furnished with each converter. Adapters may also be secured, by means of which these converters can be used in sizes of lamps other than No. 3.

Ceiling Fan Blade

The four-leaf-clover fan blade shown in the accompanying illustration is a development in ceiling fan blades for circulating air in crowded rooms as restaurants and the like. These blades are made of thin sheet metal, suitably decorated, and equipped with standard castings, so as to be interchangeable with the blades of any of the standard types of fan motors. The action of these fan blades is the reverse of that of ordinary paddle designs. Instead of blowing down the hot air from the upper portions of the room on the head of the occupants, causing disagreeable drafts, annoyance from smoke, etc., fresh cool air from the lower part of the room is drawn up and distributed horizontally along the plane of the

FOUR-LEAF-CLOVER SHAPED CAILING FAN BLADE

blades. This action, it is said, greatly increases cooling effects through improved circulation. It is also claimed that because of the principle employed in the design of these blades, the amount of air handled is greater than that handled by any of the ordinary paddle blades, while the power consumption at the same speed is less. These fan blades are a product of the Roth Wind Power Ventilator and Fan Company, 18 East Forty-first Street, New York City.

Combination Table Stove

The combination electric table stove shown in the accompanying illustration consists of a steel stand and a rectangular deep water pan with cover, all nickel plated finish. The heater consists of two steel plates welded together and inclosing between them the heating element. The water pan and heater are provided with ebonized wooden handles and the latter contains the terminals of the heating element. Additional accessories furnished with this stove are a toasting screen and a broiling screen. The device is equipped with 6 ft. of flexible connection cord and a feed-through three-heat switch. A tray upon which to rest the stove during use is also included.

This appliance affords a very complete outfit as a combination frying pan, griddle or hot plate, and the three-

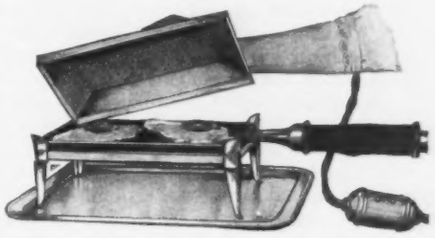


TABLE STOVE THAT CAN BE IMMERSED IN WATER FOR CLEANING

heat feed-through switch not only gives control of the temperature, but assists in preventing the use of unnecessary current. Another noteworthy feature to which attention is called is that the entire device can be immersed in water for cleaning. The Cutler-Hammer Company of Milwaukee, Wis., is the maker of this stove.

Motor Starting Switches

Steel inclosed motor starting switches designed for small three-phase motors have been developed by the Detroit Fuse & Manufacturing Company of Detroit, Mich. The switches are of the double-throw, knife-blade type with the running side arranged for fuses. A steel latch inside the cabinet prevents throwing the switch from off to running position without first being thrown into the starting position. This latch also makes necessary a quick change from starting to running position.

The switch is equipped with a lock-off device which prevents carelessness in closing the switch while someone is working on the line or apparatus controlled by the switch. This motor

STARTING SWITCH FOR SMALL THREE-PHASE MOTORS

starting device is furnished with star-delta starting connections, and when so used a separate main line switch must be installed ahead of the starting switch in accordance with the National Electrical Code.

Root Mean Square Current Meter

In order to measure the root mean square current expeditiously, accurately and economically, Mr. J. L. Davis in 1910 invented the original root mean square current meter. It has proven to be a very convenient and valuable instrument, especially in railway testing work, and should be equally valuable in the industrial field when variable current values are to be measured in terms of the root mean square value.

The measurement of current by this meter depends upon the generation of heat, by passing all or part of the current through a resistance immersed in a given quantity of water. Since the heat generated is proportional to the square of the current, the temperature of the water will (except for heat losses) be raised in the same proportion. Every change in current value will virtually be integrated, on the basis of the square of the current, at infinitely small time intervals, by the rising temperature of the water. Rapid radiation of heat is prevented by the use of a vacuum jar. To determine the r.m.s. current it is only necessary to observe the elapsed time and the rise in water temperature. By applying these values to current curves the r.m.s. current can readily be determined.

The principles on which this instrument is built free it from many of the difficulties of meters in which magnets and moving parts are employed. It will measure the effective or r.m.s. current values on either alternating or direct current and, unlike many alternating-current instruments, its accuracy is not affected by frequency, wave form, etc.

The original meter consists of a small coil supported by two small rods passing through a cork. The rods serve to conduct the current to the coil from the terminals on the top of the element. The thermometer is supported at the lower end by an insulating disc and metal clip. Originally, the top of the thermometer was held by the cork through which the rods pass. With this instrument it was necessary to remove the cork and element to read the thermometer, which permitted heat to escape. This, while not serious, had a slight effect on the accuracy of the instrument. This meter was arranged for use on direct-current only. The shunt was designed for three different current values.

The present meter as made by the Westinghouse Electric & Manufacturing Company has an element consisting of a resistance wire supported on porcelain insulators, mounted on a metal framework. The leads to the resistor are taken through the cork to terminals on the top of the meter. Heavy extra flexible leads are used to connect the meter terminals to the shunt or transformer secondary. The lower end of the frame holds four spring fingers which prevent the element from swinging sidewise and breaking the glass container.

In operation, the temperature of the water tends to be slightly higher at the top than at the bottom of the water column. A stirring rod, in the hollow tube which supports the framework of the element, is attached to two vanes, which, when moved up and down, thoroughly mix the water, causing a uniform temperature throughout. This is used previous to taking temperature readings.

A 100 deg. C. thermometer is provided with a special bushing, and is inserted through a hole in the cork until the bushing is seated in the lid and holds the thermometer firmly. When the thermometer is not in use, the hole in the lid is closed by a small cork attached to a chain. A standard vacuum jar is used to hold the water and element. In case of breakage, which is very infrequent, these vacuum bottles can be bought in the open market. Breakage is usually the result of accident or very rough usage, such as an ordinary voltmeter or ammeter would be unable to withstand without injury.

Special shunts are used for direct-current work. They are made of manganin, and are provided with removable covers, arranged to permit all connections to be made before putting the cover in place. This feature protects the operator and others from all live parts. The supporting straps are so arranged that the shunt can be placed on the floor and still get proper ventilation. It can also be mounted underneath the bottom of a car, or on a wall by means of ordinary wood screws or bolts.

With direct current it is permissible to use the instrument on 1500 volt circuits, the element and shunts being designed for this voltage. They can be used on any higher voltage, provided the instrument, shunt, leads and operator are properly insulated from the opposite side of the circuit. On railway motor equipments where ground return is used, the shunt should be connected in the circuit on the ground side of the motors. This gives maximum safety and permits the use of the meter on the highest voltage.

On alternating-current the instrument is applicable to any voltage, provided a series transformer with standard insulation is employed.

For making a test on direct-current apparatus, a shunt of the proper capacity is connected in the circuit carrying the current to be measured. Where the r.m.s. current values are sufficiently low the meter is connected directly in the circuit. For alternating current, a series transformer with a 5-amp. secondary is used instead of a shunt.

A definite quantity of distilled water, at a temperature of approximately 20 deg. C., is put in the vacuum jar at the beginning of the test. When starting with the water at this temperature, the instrument can be kept in the circuit for a period of approximately ten hours, provided the r.m.s. current does not exceed the rating of the element or shunt. As a matter of fact, the test can be started with the water at almost any temperature which will permit it to be finished without bringing the water too near the boiling point. A correction factor is applied for initial temperatures which are more than 5 deg. C. above or below an initial temperature of 20 deg. C. Simultaneous readings of water temperature and time should be taken at frequent intervals. In tests on railway equipments, these readings can be taken at such points as will facilitate the determination of r.m.s. currents for any section of a run. In fact, in any class of variable load work, the time of taking the readings can be so arranged that the r.m.s. current can be obtained for the whole period of test, or any intermediate period, or combination of periods.

The calibration curves are determined by passing a constant current through the meter and plotting the results of these readings, separate tests being made for each current value. These curves show only the current which passes through the element. Assume that with a 50 amp. shunt in the circuit, the temperature rise for the first five hours of the test is 25 deg. C. The curves show that the r.m.s. current through the element is 3 amp. Multiplying this value by 15 (the multiplier for this particular shunt) gives a value of 45 amp. for the r.m.s. current in the main circuit.

It is said that the effect of radiation and conduction of heat from the bottle is slightly greater at the higher temperatures. In the ordinary test, the final temperature of the water will usually not be over 60 to 70 deg. C. (40 to 50 deg. rise above an initial water temperature of approximately 20 deg. C.). In the usual test the effect of radiation of heat will be relatively small, being approximately 6 deg. in a period of ten hours. The average test will not cover more than two to six hours.

This meter is most valuable under varying load, varying cycle conditions. These conditions are probably more prevalent in railway work than in any other line; but industrial, mill and mining work undoubtedly follow as a close second. In each class of work there are motors and generators working beyond their thermal capacity; while on the other hand, there are probably as many which are not working up to their full rated capacity. In either case the over-all operation is inefficient. The first, because the life of the insulation is short, and repair bills in general are unnecessarily high. The second, because these machines are not operating at their maximum efficiency; and in the case of motor cars the excess weight must be transported at a loss, to say nothing of the excessive first cost, due to purchasing an oversized machine. These conditions can usually be avoided, or remedied, by knowing the actual load conditions under which the apparatus is working. In railway work this applies to equipments for locomotives, cars, substations, power stations, etc., either alternating or direct current.

In industrial, mill and mine work the instrument can be used to great advantage in checking the load on motors for blooming mills, bridges, hoists, cranes, ore bridges, building elevators, mine locomotives, mining machines and auxiliary motors of all kinds.

Trade Notes

E. TUCKER, who recently retired as vice-president of the Greenwood Advertising Company (Western), has formed a new company under the name of the Tucker Electric Sign System for the purpose of designing, manufacturing and leasing electrical advertising signs and accessories. Mr. Tucker's new headquarters will be at 1112 West Sixteenth Street, Los Angeles, Cal.

ALLEN & GARCIA COMPANY, Chicago, Ill., announces the establishment of a power department which will be in charge of C. M. Garland. The electrical work in connection with this department will be handled as at present by W. C. Adams. The work of the department will consist of consultation, design, construction, operation and the scientific management of power properties, steam, gas and electrical, together with appraisals and reports.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has recently taken a long lease on and now occupies a large four-story building situated on the corner of Thirty-sixth Street and Tenth Avenue, New York City. The entire building is being utilized as a service station, repair shop and warehouse. While the former shop, located at 512 West Twenty-third Street, was equipped to handle repairs of every kind, type and size of electrical machinery, and was one of the largest in New York City, employing about seventy men, it was inadequate to care properly for the demands made upon it.

BOUND BROOK OIL-LESS BEARING COMPANY of Bound Brook, N. J., announces the election of its second vice-president, Spencer Weart, as president, and the election of the general manager, George Oakley Smalley, as treasurer.

THE COMBUSTION ENGINEERING CORPORATION, 11 Broadway, New York City, announces the doubling of the size of its New York offices. This change was made to accommodate the increase in business due to the constantly increasing demand for its type E stoker for bituminous coal, and the Coxe stoker for anthracite coal. The company further announces the organization of six additional erecting units, each under the direction of a superintendent for field work, and the establishment of a service department under the direction of John Morris, who has been associated with the company since its organization. Mr. Morris will have under his direction a corps of competent engineers who will keep in constant touch with the trade with the idea of rendering the customers of the corporation, free inspection and engineering service at all times. The company closed the last year (1916) with more than three times as much business as it had ever done in any one year before, and with orders booked ahead for delivery far into the coming year.

RADIO OUTFITS ADMITTED FREE OF DUTY.—The "incalculable benefits" of wireless telegraphy are so great that tariff duties should not stand in the way of free entry of radio apparatus, was the decision of the United States Court of Customs Appeals recently handed down in the case of the Government owned Panama Railroad Company, which operates a line of steamships between New York and Canal Zone points. From the testimony it appeared that the wireless stations installed on the boats in 1912, following the enactment by Congress of a law requiring ocean passenger vessels to be equipped with radio apparatus, proved unsatisfactory, and by 1914 had, according to expert testimony, become "old-fashioned." The company ordered wireless outfits constructed in a foreign country and shipped to New York, where later they were installed aboard the liners. The stations, as imported, were complete in every detail, including receivers, electrical apparatus and wireless outfit. A special agent of the Treasury Department reported to Collector Malone that, as the new outfit had been placed on "old" boats, the equipment was excluded from the tariff's provision for "all articles necessary for vessels' outfit and equipment," appearing in Subsections 5 and 6 of Paragraph J of Section 4 of the Tariff act of 1913. The collector accordingly demanded a 20 per cent tax as "manufactures in chief value of metal, not specially provided for," as appearing in Paragraph 167. The Board of General Appraisers sustained the railroad's claim for duty exemption, but the Government appealed. Judge Barber, who wrote the decision for the court, decided that in a strictly technical sense the replacing of the old by the new apparatus constituted a "repair" within the meaning of one of the provisions of Paragraph J.

THE GENERAL ELECTRIC COMPANY has recently organized an industrial service department to supervise education, employment, and provision of opportunities for advancement of employees at the Schenectady plant of the company, under the management of E. B. Merriam, for several years assistant engineer of the switchboard department of the company.

KANDEM ELECTRIC COMPANY, INC., distributer for Menominee Electric Manufacturing Company, has moved to 58-60 Reade Street, New York City.

J. G. WHITE & COMPANY, 43 Exchange Place, New York City, announces the election as vice-president of the company of Russell B. Marchand, formerly treasurer of the company; Douglas I. McKay, formerly assistant to the president, and Sanger B. Steel, formerly manager of Caine-Webber & Company, Chicago.

PRECISION INSTRUMENT COMPANY, New York City, announces that the Vincent & Gilson Engineering Company is representing them in New York at 30 Church Street.

WARD MOTOR VEHICLE COMPANY, Mount Vernon, N. Y., has put out a memorandum book of vest-pocket size. In addition to the usual information found in such books there are many tables designed to facilitate calculations. Anyone desiring a copy of this book will receive one by addressing the company.

Trade Publications

INSULATORS.—The Locke Insulator Company of Victor, N. Y., is distributing Supplement No. 1 to its "Insulator Book." This book presents ten designs of pin-type insulators for voltages ranging from 27,000 to 80,000.

RAILWAY SYSTEM.—The Strauss Inverted Elevated Railway System is described and illustrated in a bulletin recently issued by the Strauss Transit System, Inc., 185 Jefferson Avenue East, Detroit, Mich.

ELECTRIC APPLIANCES.—The Hotpoint Electric Company of Ontario, Cal., is distributing a list price sheet on Hotpoint electric appliances, superseding all previous issues.

ENGINEERING DATA.—Data for Central Station Engineers is the title of a bulletin now being distributed by the Metropolitan Engineering Company, 35 Vestry Street, New York City. This bulletin contains forty-five pages of interesting and useful data for the central station man.

SAFETY PRACTICES.—The National Council, Continental and Commercial Bank Building, Chicago, Ill., has prepared three safe-practices leaflets, entitled "Ladders," "Stairs and Stairways" and "Boiler Rooms." These leaflets are presented in loose-leaf form and discuss accident hazards and the best practices for their elimination.

BANK TELLER'S MACHINE.—The Teller Protector Company, Inc., of Richmond, Va., has issued a booklet descriptive of its Teller's Protector Machine.

PIPE STANDARDS.—The National Tube Company of Pittsburgh, Pa., has prepared and is distributing an appendix to its 1913 edition of Book of Standards. This contains tables and useful information pertaining to tubular goods as manufactured by this company. For the most part, the information in this book is supplementary to the first book, but in several cases it replaces other data entirely. The book contains almost 200 pages of useful information.

SOOT BLOWERS.—"Increasing To-day's Profits" is the title of a book recently published by the engineering department of the Diamond Power Specialty Company of Detroit, Mich. The book is of special interest to the man who is responsible for the economical operation of the power plant. The various points discussed are illustrated making the text easily understandable. The text is written to interest both the technical man and the person who is not acquainted with the technical phraseology. This company has also issued new editions of Bulletins 118 and 119. The first describes in a very interesting manner the new metal Insuluminum, with high heat resisting qualities and which is used in the construction of the Diamond Soot Blowers for water-tube boilers. Bulletin 119 describes and pictures the Diamond Mechanical Soot Blower system for water-tube boilers.

New Incorporations

THE DEKALB (Mo.) LIGHT & POWER COMPANY has been chartered with a capital stock of $16,500 by R. D. Reed, William Call and H. L. Graves.

THE ELECTRIC LIGHT & POWER COMPANY of Ferdinand, Ind., has been incorporated by William R. Sauer, John P. Reinacker and Richard Eiberg. The company is capitalized at $10,000.

THE SOUTH DAKOTA HYDRO-ELECTRIC COMPANY of Pierre, S. D., has been incorporated with a capital stock of $15,000,000 for the purpose of developing the water power of the Missouri River by the erection of a large dam at Big Bend. George W. Adams of Council Bluffs, Iowa, is at the head of the company.

THE DIXIE ELECTRIC COMPANY of Sumter, S. C., has been incorporated with a capital stock of $3,000. The officers are: Young Shackleford, president, and B. C. Wallace, Jr., secretary and treasurer.

THE OSTERBURG (Pa.) LIGHT & POWER COMPANY has filed application for a charter for the purpose of supplying electricity for lamps and motors in St. Clairsville, Osterburg, Imler, King, Claysburg, Sarah Furnace, Sproul and surrounding territory in Bedford and Blair Counties. The incorporators are: D. O. Rohm, W. H. Rohm and John H. Zinn.

THE W. S. BARSTOW MANAGEMENT ASSOCIATION of New York, N. Y., has been incorporated by O. C. Swenson, J. B. Taylor and W. S. Barstow of Great Neck, N. Y. The company proposes to manage and supervise public utility properties, light, heat and power plants.

THE ELECTRICAL MANUFACTURING COMPANY of Wilmington, Del., has been incorporated with a capital stock of $250,000 by F. O'Keefe, George C. Steigler and E. E. Wright of Wilmington, Del. The company proposes to manufacture electrical devices for cleaning, polishing, etc.

THE NEW JERSEY ELECTRIC & AUTO SUPPLY COMPANY of Newark, N. J., has been incorporated to manufacture electrical goods for automobiles. The incorporators are: Jerome J. Rafferty, H. L. and M. B. Doolittle of Newark, N. J.

THE EMPIRE SALES COMPANY of Newark, N. J., has been incorporated by J. W. Palmer, H. A. Reeves and W. Hagney. The company is capitalized at $125,000 to manufacture motors.

THE STORAGE BATTERY SUPPLY COMPANY of Hackensack, N. J., has been incorporated to manufacture storage batteries. The incorporators are: G. R. Williams, 313 Main Street, Hackensack, N. J., William J. Hurst and W. J. Dailey.

THE HERZOG LAMP COMPANY of Union Hill, N. J., has been incorporated, with a capital stock of $25,000, by Edward J. Simon, 149 Palisade Avenue, Union Hill; John T. Simon and William F. Herzog. The company proposes to manufacture incandescent lamps.

THE EFFICIENCY ELECTRIC COMPANY of East Palestine, Ohio, has been incorporated, with a capital stock of $30,000, by A. J. Wayman, L. M. Keyes, William G. Morris, J. C. Chamberlain and R. N. Chamberlain.

THE J. T. CRAIG ELECTRIC COMPANY of Crafton, Pa., with a capital stock of $5,000, by J. T. Craig, P. J. Morgan and James Rooney of Crafton.

THE ARROWHEAD ELECTRIC COMPANY of Milwaukee, Wis., has been chartered, with a capital stock of $25,000, by A. U. Stetten, L. E. Fichan and E. W. Passmore.

THE MAXWELL ELECTRIC COMPANY of Steubenville, Ohio, has been incorporated, with a capital stock of $10,000, by R. B. Maxwell and others.

THE NATIONAL ELECTRIC COMPANY of Jacksonville, Fla., has been incorporated, with a capital stock of $5,000, by R. B. Murphy, R. L. Chamberlain and C. E. Gervais.

THE FLAGG MARINE SIGNAL COMPANY has been incorporated under the laws of the State of Massachusetts, with a capital stock of $100,000, to manufacture the Flagg safety fog horn, invented by J. Walter Flagg, treasurer of the Worcester (Mass.) Loan Company, and electrical supplies. It is not yet decided where the plant will be located.

New England

RUMFORD, ME.—Preparations are being made by the Rumford Falls Power Company for the installation of two 8000-kw. (each), 11,000-volt generators. Charles A. Mixer is superintendent.

YARMOUTH, ME.—The town of Yarmouth has applied to the State Legislature for permission to construct and operate a municipal electric-light plant.

BOSTON, MASS.—Bids will be received by the schoolhouse commissioners of the city of Boston, 1007 City Hall Annex, Boston, until Feb. 23 for construction of an Elementary School for upper and lower grades, Oliver Wendell Holmes District, Harvard and Glenway Streets, Dorchester, Boston, Mass. A deposit of $25 will be required for a complete set of plans and specifications. For a set of heating and ventilating or electrical plans with specifications a deposit of $15 will be required.

CHELSEA, MASS.—Plans are being considered by Mayor Edward E. Willard for the installation of a municipal lighting and heating plant for the City Hall, central fire station and public library.

PROVIDENCE, R. I.—Plans are being considered by the City Council to utilize the waste water that will run over the large water supply dam at Kent, now under construction, to generate electricity for lighting the streets of the city of Providence. R. L. Brunet, engineer of the city public service board, has been authorized to secure data as to the amount of water that will pass over the dam.

SOUTH NORWALK, CONN.—An extensive system of ornamental lighting, covering nearly 2 miles of streets, is under way with the expectation that it will be completed this year. Steel standards and low-wattage Mazda C series lamps will be used. Plans are being considered for a new generating station for the South Norwalk Electric Works, to be located on property already acquired on the local harbor front. Albert E. Winchester is general superintendent.

Middle Atlantic

BROOKLYN, N. Y.—Bids will be received by the President of the Borough of Brooklyn, Room No. 2, Borough Hall, Brooklyn, until Feb. 21 for furnishing and installing the mechanical equipment of the sewage pumping station at Morgan Avenue and Maspeth Avenue, section No. 3, of storm sewers and sanitary sewers in Maspeth Avenue. Blank forms and further information may be obtained at the office of Bureau of Sewers, 215 Montague Street, Brooklyn.

BROOKLYN, N. Y.—Bids will be received by the Department of Health, Centre and Walker Streets, New York, until Feb. 21 for furnishing material and labor required in connection with alterations and other work in the kitchen building at Kingston Avenue Hospital, Borough of Brooklyn, as follows: (a) Kitchen equipment and platform scale; (b) refrigerators; (c) gas and electric lighting fixtures; (d) electric dumbwaiter; (e) electric freight elevator; (f) plumbing and gas fitting. Plans may be seen and further information obtained at the above office.

BUFFALO, N. Y.—Plans are being prepared by the Central Star Laundry Company for the erection of a power plant at 21 Northland Avenue. R. J. Reidpath & Son, Builders' Exchange, Buffalo, is architect.

CANISTEO, N. Y.—Orders have been placed by the Up-to-Date Advertising Company of Canisteo for electric generators of 150 hp. to supply electricity to operate its entire plant. The plant will be equipped for electrical operation throughout. J. H. Anderson is manager.

HAMBURG, N. Y.—Extensive improvements are contemplated by the Intervillage Electric Company of Hamburg to its plant and transmission lines in Erie County, involving an expenditure of about $10,000. The work will inculde the construction of a new power house in Hamburg, and the erection of additional electric transmission lines between Hamburg, Depew and Lancaster. The Intervillage Electric Corporation and the Depew, Lancaster & Buffalo Electric Company of Depew contemplate consolidating their lines for the more economic distribution of power. Both companies secure energy from the Niagara, Lockport & Ontario Power Company.

KINGS PARK, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until Feb. 28, for construction, heating, plumbing, drainage and electric work for Employees' Home at Kings Park (N. Y.) State Hospital. Drawings and specifications may be consulted at the Kings Park Hospital, New York office, Department of Agriculture, Room 1224, Woolworth Building, and at the Department of Agriculture, Capitol, Albany. Lewis F. Pilcher is architect.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—Bids will be received by J. T. Fetherston, commissioner of street cleaning, Room 1244, Municipal Building, New York City, until Feb. 21 for furnishing as follows: Class (1) 34 gasoline-electric tractors and spare parts; class (2) 34 gasoline tractors and spare parts. Blank forms and further information may be obtained at the above office.

NIAGARA FALLS, N. Y.—The contract for the construction of the new substation of the International Railway Company of Buffalo, to be erected at Twenty-fourth Street and Allen Avenue, has been awarded to Braas Brothers. The cost of building is estimated at $31,000 and the equipment at $150,000. This station will supply energy to operate the Niagara Falls street car lines and also for the International Company's new fast service line from Niagara Falls to Buffalo, now under construction.

PALMYRA, N. Y.—Bids will be received by W. W. Wotherspoon, superintendent of public works, Capitol, Albany, N. Y., until Feb. 20 for construction and equipment of a power station at Lock 29, Barge Canal, Palmyra, N. Y., under canal contract 141.

ROCHESTER, N. Y.—Application has been filed by the Rochester Railway & Light Company for permits to erect three buildings, to cost about $140,000. These structures will form part of the power plant now under way at the Lower Falls and will include a power station, 75 ft. by 90 ft.; operating house for dams, 25 ft. by 15 ft., and an intake and rack house, 36 ft. by 100 ft.

PHILADELPHIA, PA.—Work has begun on the erection of an addition (eight stories high) to the plant of the Electric Storage Battery Company, at the corner of Nineteenth Street and Allegheny Avenue, to cost about $500,000.

PHILADELPHIA, PA.—Plans are being considered by the Lehigh Valley Railway Company, it is reported, for equipping its main line from Jersey City to Wilkes-Barre, a distance of 176 miles, and the Mahanoy and Hazleton division from Penn Haven Junction to Mount Carmel, 51.8 miles, a total of 228 miles, for electrical operation, at a cost of from $10,000,000 $20,000,000.

PITTSBURGH, PA.—The Board of Public Education has sold to Allegheny County the South School, at Ross and Diamond Streets. The County Commissioners, it is understood, will erect a power house on the site.

PITTSBURGH, PA.—The City Council has adopted an ordinance authorizing the Mayor and the director of the department of charities to advertise for bids for the installation of an electric-light plant in the power house at Mayview and also appropriating the sum of $46,500 to pay for same.

ATLANTIC CITY, N. J.—Plans have been prepared by the Bell Telephone Company for the erection of a five-story telephone exchange building at Pacific and Mount Vernon Avenues.

BAYONNE, N. J.—A petition has been presented to the City Commissioners by the Lower Central Broadway Business Men's Association for the installation of a street-lighting system on Broadway from Tenth to Eighteenth Streets.

NEWARK, N. J.—Plans are being considered by the building committee of the Common Council for the installation of a high-pressure water system and electric-lighting plant at the East Side Public Bath, to cost about $12,000.

PERTH AMBOY, N. J.—The Public Service Electric Company will supply energy to the plant of the Roessler & Hasslacher Chemical Company on Fayette Street. An underground conduit system will be installed from the power station on Buckingham Avenue to the chemical plant.

BOONSBORO, MD.—The power house of the Antietam Power & Electric Lighting Company on Antietam Creek at Breathedsville was damaged recently by a large flywheel breaking loose.

OCEAN CITY, MD.—The Delmarvia Utility Company is contemplating changing its system to 60 cycle, three phase, 2300 volts in the next few months. H. T. Moore is manager.

CHARLESTON, W. VA.—The Fairmont & Clarksburg Power Company has applied to the Public Service Commission for permission to condemn land and construct four dams across the Buckhannon, Middle Fork and Tygart's Valley Rivers for the purpose of developing water power to generate electricity.

GRAFTON, W. VA.—The Grafton Gas & Electric Company contemplates the installation of new equipment, doubling the output of its plant, at a cost of about $10,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 12 for the installation of underground concrete oil reservoirs, piping, boilers, heaters, buildings, etc., at the naval station at Guantanamo, Cuba.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 26 for furnishing and installing one 1000-kw. direct-current turbo-generator at Portsmouth, N. H., and one 1000-kw. turbo-alternator at Charleston, S. C. Drawings and specifications may be obtained on application to the above bureau or to the commandants of the navy yards named.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Mare Island, Cal., schedule 721—48 vibrating bells, 30 steam brass whistles, 900 lb. copper wire; Schedule 719—8400 ft. plow steel wire rope; Schedule 713—one 30-in. motor-driven engine lathe. Philadelphia, Pa., Schedule 704—15 tool and carbon boxes, six searchlight projectors, 30 wooden reels to carry cable, 13,500 ft. double-conductor flexible cable, 1500 carbons for 30-in. lamps, 11 gasoline generator sets; Schedule 701—one air compressor; Schedule 712—24 water gages; Schedule 700—two main air pumps. Brooklyn, N. Y., Schedule 716—1800 lb. crankshaft, 28 steam traps; Schedule 703—furnishing and installing engine room, mechanical telegraphs; Schedule 711—21,500 ft. interior communication cable, 251,200 ft. single and twin-conductor wire; Schedule 702—two ringing dynamotors, one telephone motor generator, 141 fire control telephones, etc.; Schedule 697—miscellaneous insulating material. Washington, D. C., Schedule 707—34 steel recoil cylinders, miscellaneous tampions, sponge heads, rammer heads, etc., 206,742 lb. lapwelded steel tubes. Norfolk, Va., Schedule 712—miscellaneous seamless steel boiler tubes. Boston, Mass., Schedule 717—one engine outer telegraph system. Brooklyn, N. Y., Boston, Mass., Schedule 702—telephone switchboard. Applications for proposal blanks should designate the schedule desired by number.

North Central

GRAND RAPIDS, MICH.—A permit has been granted to the Consumers Company for the erection of an addition to its steam power plant on Wealthy Street, S. W., to cost about $68,000.

BLUFFTON, OHIO.—At an election to be held March 6 the proposal to issue $35,000 in bonds for improvements to the municipal electric-light plant and water-works system will be submitted to the voters.

CLEVELAND, OHIO.—The construction of a substation at 2162 Ashland Road, to cost about $300,000, is reported to be under consideration by the Cleveland Railway Company.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, Ohio, until Feb. 27 for surface condenser for the department of utilities, division of light and heat. Specifications may be obtained on application to the office of the division of light and heat, room 305, new City Hall.

DAYTON, OHIO.—Bids will be received by the Board of Education of the city school district of Dayton, at the office of C. J. Schmidt, clerk of board, until Feb. 27 for electric wiring, electric-light fixtures, vacuum cleaner, plumbing and gas fitting and heating and ventilating for the Cleveland School, located in Ohmer Park, Dayton. Bids will also be received at the same time and place for electric wiring, electric-light fixtures, vacuum cleaner, plumbing and gas fitting, and heating and ventilating for the Whittier School, located in Edgemont, Dayton. Plans and specifications may be obtained at the office of Albert Pretzinger and Edward P. Musselman, architects, 1155 Reibold Building, Dayton.

FOSTORIA, OHIO.—The installation of a sprinkler system and construction of a new power plant is reported to be under consideration by the Seneca Wire & Manufacturing Company, of Fostoria.

JAMESTOWN, OHIO.—The plant and holdings of the Jamestown Electric Light Company has been taken over by the Dayton Power & Light Company. The local power plant will be closed down as soon as transmission lines to Jamestown are erected to supply energy from the Dayton power plant.

KENT, OHIO.—Plans are being prepared for rebuilding the local electric plant, which was recently taken over by the Northern Ohio Light & Traction Company. It is proposed to use the power house for a substation to distribute electricity for lamps and motors in Kent.

SCOTT, OHIO.—The installation of a municipal electric-lighting system in Scott is reported to be under consideration.

COVINGTON, KY.—The City Commissioners are considering the question of establishing a municipal electric-light plant in Covington.

MURRAY, KY.—The contract for construction of the municipal electric-light plant has been awarded to W. E. King, of Covington, Tenn.

BREMEN, IND.—Specifications are now being prepared for changing the municipal pumping system from steam to electric drive. E. R. Haus is superintendent.

INDIANAPOLIS, IND.—Bids will be received by the board of school commissioners of the city of Indianapolis, Ind., Wimmer Building, until Feb. 27 for work and materials in the Central Library, Meridian and St. Clair Streets, separate bids to be submitted as follows: (1) For construction and erection of the fixed and movable wood furniture and other joiner and cabinet work; (2) for furnishing and installing gas and electric-lighting fixtures. Plans and specifications may be obtained upon application to Paul P. Cret & Zantzinger, Borie & Modary, Architects, 139 South Fifteenth Street, Philadelphia, Pa., upon deposit of $10.

MONGO, IND.—The Farmers' & Merchants' Light & Power Company, of Mongo, has applied to the Public Service Commission for authority to issue $500,000 in capital stock, the proceeds to be used to purchase and improve five dams and water power plants on the St. Joseph and Fawn Rivers in Northern Indiana and Southern Michigan. The cost of improvements and hydroelectric developments is estimated at $278,250.

NAPPANEE, IND.—Work has been started on the installation of a 375-kva., 60-cycle, 2300-volt Westinghouse condensing turbine in the municipal electric-light plant. Myron D. Kizer is manager.

TIPTON, IND.—Improvements to the municipal electric-light plant, involving an expenditure of about $12,500, are under consideration.

CHICAGO, ILL.—The Turner Manufacturing Company, manufacturers of picture frames, has purchased an entire block on the Chicago, Burlington & Quincy Railroad on Ogden Avenue, one block west of Crawford Avenue, on which it proposes to erect a new factory, at a cost of about $225,000. The plans provide for a power plant, dry kilns and sprinkler system.

CHICAGO, ILL.—Bids will be received by the South Park Commissioners, Fifty-seventh Street and Cottage Grove Avenue, Chicago, until Feb. 21 for construction complete of an electric substation at Marquette Road and Hamilton Avenue, including sewer and electrical conduit. Specifications and blank forms may be obtained at the above office. J. F. Neil is secretary.

CHICAGO, ILL.—The Chicago Telephone Company has begun work on the erection of a new office building on Washington Street, between Franklin and Market Streets. It will be eleven stories high and will house the Main, Franklin, Central and Randolph exchanges. Work has also been started on a new building to be known as the Kildare office, which will serve a part of the territory now being handled from the Irving office. It is also proposed to erect another building to be known as the McKinley office, to be located at 2238 West Thirty-seventh Street. An addition is also proposed to the West office, to provide more space for switchboards. Plans for outside construction by the company provide for the building of a new tunnel to carry its cables under the Calumet River at Ninety-fifth Street, and another tunnel under the north branch of the Chicago River at Irving Park Boulevard.

DU QUOIN, ILL.—The proposal to install an ornamental lighting system in the downtown district will be submitted to the voters this spring.

GIBSON CITY, ILL.—Bids, it is reported, will be received by the city clerk, Gibson City, until April 1 for construction of water-works system and electric-light plant.

HARRISBURG, ILL.—Work will begin this spring by the Southern Illinois & St. Louis Railway Company of Harrisburg on the construction of the proposed electric railway to connect Harrisburg, Pittsbugh, Marion, Johnston City, West Frankfort, Benton and Herrin, a distance of 60 miles. Contract has been awarded for 18 motor cars.

ROCK ISLAND, ILL.—Bids will be received at the office of the commanding officer, Rock Island Arsenal, Ill., until Feb. 28, under circular 1042, for furnishing four hydraulic turbine units complete and four additional ring curbs for future units. For further information address George W. Burr, commanding officer ordnance department, U. S. Army.

AMERY, WIS.—E. J. Schneider, owner of the local hydro-electric power plant, has awarded contract for the construction of a dam and the development of another similar plant (also on the Apple River) 4 miles below Amery. The proposed dam, which will be built of reinforced concrete, will be 200 ft. long with a 23-ft. head. It is estimated that 800 hp. can be generated, although but 480 hp. will be used at present. Electricity generated at the plant will be transmitted to Turtle Lake, Almena, Comstock and Clayton, Wis.

BROOKLYN, WIS.—The Village Trustees have granted the Brooklyn Electric Company a franchise to install a distribution system in this village.

CUDAHY, WIS.—The Federal Rubber Manufacturing Company is contemplating an addition to its power plant in Cudahy, at a cost of about $200,000.

CROSBY, MINN.—The installation of a municipal electric-light plant in Crosby is reported to be under consideration.

NORTHROP, MINN.—The village of Northrop is contemplating the installation of an electric-lighting system in the near future. Energy will be obtained from the electric plant at Rapidan.

ST. PAUL, MINN.—The St. Paul Gas Light Company, it is reported, contemplates the construction of a hydroelectric power plant on the upper levee, to cost about $1,000,000.

BURLINGTON, IOWA.—Bids will be received by the Citizens Water Company, Burlington, Iowa, until Feb. 28 for a horizontal cross compound crank and fly wheel condensing pumping engine with a capacity of 4200 gal. per minute for pumping water from the river to the settling tanks. Alternate proposals will also be received at the same time for a centrifugal pump for the same work. The centrifugal pump may be driven by a steam turbine or by a compound Corliss condensing engine. Frank Lawlor is superintendent.

OSAGE, IOWA.—The Osage Electric Light, Heat & Power Company has been granted a new franchise and also a new contract for street-lighting. The company is now in the market for 46 ornamental single-lamp standards, complete with Novalux tops suitable for 250-cp. series Mazda, type C, lamps. Everything complete except the lamps; also for approximately (not less than) 6000 ft. of No 8 double-conductor cable. Thomas Ferris is manager.

ROCKWELL CITY, IOWA.—The general contract for the construction of administration and pathology buildings and power house at the Industrial Refuge for Females at Rockwell City has been awarded to the Bailey-Marsh Company, Metropolitan Life Building, Minneapolis, Minn. The cost of the work is estimated at $100,000. H. E. Liebbe is state architect.

PORTAGEVILLE, MO.—The local electric-light plant, recently destroyed by fire, causing a loss of about $9,000, it is reported, will be rebuilt. J. B. Drerup is owner.

KIMBALL, S. D.—The South Dakota Hydroelectric Corporation, recently incorporated with a capital stock of $15,000,000, proposes to develop the water powers of the Missouri River in South Dakota to operate hydroelectric plants. George W. Adams of Council Bluffs, Iowa, is promoter. The head office of the company will be located in Kimball.

REDFIELD, S. D.—Bids will be received by the South Dakota State Board of Charities and Corrections at the State School for Feeble-Minded at Redfield, until March 6 for the construction of a main building, including general contract work, heating and ventilating, plumbing and electrical work, in accordance with plans and specifications prepared by C. H. Johnson of St. Paul, Minn., architect. Copies of plans may be obtained at the office of the architect upon deposit of $25.

FULLERTON, NEB.—The Fullerton Electric & Power Company contemplates the construction of a dam across the Cedar River.

ERIE, KAN.—An ornamental street-lighting system, consisting of 24 single units, is now being installed by the Electric Light Department.

HANOVER, KAN.—The Council is contemplating the purchase of an oil engine of about 100 hp., and two new alternating-current generators, one of which is to replace the one now in use. It is possible that a new building will be erected. J. G. Granzer is superintendent.

KANSAS CITY, KAN.—The Water & Light Department has recently entered into contracts with Wilson & Company, packers, and with the Kansas City Tire & Rubber Company to supply electricity at their plants. Arrangements are being made by both companies for the installation of electrical equipment.

LYNDON, KAN.—The erection of an electric transmission line to connect with the local central station is under consideration by the towns of Scranton, Overbrook and Carbondale. In view of this the installation of a 250-hp. Busch, Sulzer Diesel engine and generator in the municipal electric plant is under consideration.

MOUND VALLEY, KAN.—The Prairie Oil & Gas Company is contemplating the construction of a power plant and tank farm.

SENECA, KAN.—The electric light commission contemplates the erection of an electric transmission line to St. Benedict, a distance of 1½ miles from the present terminus at Axtell.

WICHITA, KAN.—The Wichita Railroad & Light Compay contemplates extending its College Hill line from Roosevelt Avenue to East Street. The cost of the extension is estimated at $50,000.

Southern States

RALEIGH, N. C.—Surveys, it is reported, are being made by the Carolina Light & Power Company of Raleigh for the construction of an additional power plant on the Pee Dee River below Blewitt's Falls.

PORT ROYAL, S. C.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 26 for construction of wood-frame hospital, including complete plumbing, electric-lighting and heating system, at naval hospital, Marine Recruiting Station.

AMERICUS, GA.—The Americus Public Service Company is reported to be contemplating extensions to its generating and distributing systems.

ELIZABETHTON, TENN.—Plans are being considered for the construction of a dam across Watauga River, 5 miles west of Elizabethton, to develop the water power. J. H. Grayson, of Bristol, is reported interested.

ST. BERNARD, ALA.—Plans are being prepared for extensions to the municipal electric power plant, including the installation of new equipment and water softening plant, for which $90,000 in bonds were recently voted. Edgar B. Kay, P. O. Box 151, Cincinnati, Ohio, is engineer.

CLARKSDALE, MISS.—Proposals will be received by the City Commissioners until Feb. 27 for the purchase of the following machinery: One 18-in. by 18¼-in. Harrisburg-Fleming automatic engine, directly connected to a 200-kva., 60-cycle, three-phase, 2300-volt Crocker-Wheeler generator, complete with a 9-kw., 125-volt exciter, one 32-in. Vermont marble switchboard, complete, and other plant accessories. Proposals should be addressed to R. E. Stratton, Jr., city clerk. For details see proposal columns.

GULFPORT, MISS.—Bids will be received at the office of the director of works of the Mississippi Exposition Company, Gulfport, until Feb. 21 for furnishing material and installing illuminating system and electrical work on the buildings of the Mississippi Centennial Exposition. Plans and specifications may be obtained upon deposit of $25 for plans for buildings and $5 for plans for illumination of grounds upon application to A. W. Lewin, electrical engineer, 631 Audubon Building, New Orleans, La., or John T. Connell, director of works, Gulfport, Miss.

YAZOO CITY, MISS.—Improvements are contemplated to the municipal electric-light plant, to cost about $20,000.

MARSHALL, ARK.—The electric-light plant owned by the Marshall Roller Mill Company has been purchased by Thomas Matlock. The plant will be removed to a new location and improvements made, including the installation of a new engine.

PINE BLUFF, ARK.—The control of the Pine Bluff Company, which owns the local electric-lighting, water-works and street railway systems, has been purchased by W. F. Rinebeck of Thornton, Ark.; H. C. Couch of Arkadelphia; J. H. Watkins of New York, N. Y., and others. The new owners, it is reported, propose to make extensions and improvements to the systems.

MARKSVILLE, LA.—The Marksville Electric Light & Ice Company is contemplating installing equipment to make clear ice. At present raw water is used as comes from the well. E. M. Kursheeft is vice-president and general manager.

ALTUS, OKLA.—The erection of an electric transmission line from Altus to Duke is reported to be under consideration.

ALVA, OKLA.—The property of the Alva Light & Power Company has been purchased by the Albert Emanuel Company of Dayton, Ohio. The purchase price is said to be $100,000.

BILLINGS, OKLA.—The City Council will soon call an election to vote on a bond issue for the installation of an electric-light plant.

FAXON, OKLA.—An election will be held on Feb. 20 to vote on the proposal to issue $1,500 in bonds for an electric-lighting system.

STROUD, OKLA.—Bids will be received by the town of Stroud, Okla., until Feb. 23 for furnishing material for water-works and extensions to electric-lighting system, as follows: For furnishing and installing on foundations furnished by the town, one 120-hp. Diesel oil engine, complete with all accessories, directly connected to a 75-kva., three-phase, 60-cycle, 2300-volt generator, belted type, with exciter and rheostats. Alternate bids will be received for one 120-hp. crude oil engine, semi-Diesel type with generator, or one 120-hp. natural gas engine with generator; also one 50-kva., three-phase, 2300-volt generator, one switchboard, transformers, lightning arresters, street hoods, choke coils, pump, motor and one 10,000-gal. steel fuel oil tank. Plans and specifications may be obtained at the office of the Benham Engineering Company, consulting engineer, Oklahoma City, upon payment of $5.

WANETTE, OKLA.—Bonds to the amount of $8,000 have been voted for the installation of an electric-lighting system.

WATONGA, OKLA.—The city of Watonga is reported to be considering the purchase of an oil engine for the municipal electric-light plant.

ALICE, TEX.—The electric light and power plant, owned by the Alice Cotton Oil Company, has been purchased by Morrison & McCall of St. Louis, Mo. The new owners propose to enlarge the plant and erect electric transmission lines to San Diego and a number of other towns in this section.

CLINTON, TEX.—Extensive improvements are contemplated to the local electric plant of the Northern Texas Utilities Company in the near future. R. O. Bass is local manager.

DALLAS, TEX.—Extensive improvements and extensions, involving an expenditure of from $1,000,000 to $2,000,000, are under consideration by the Dallas Automatic Telephone Company.

DALLAS, TEX.—At the election to be held in April four franchise propositions will be submitted to the voters and will include the Strickland-Hobson franchise on the lighting and street railway plants of the city, a franchise for the Dallas Automatic Telephone Company and for the Dallas Gas Company.

GUSTINE, TEX.—The Delco electric-light system in this city has been purchased by Dillard & McQuarters of Gustine. Improvements and extensions will be made to the plant and system.

PORT ARTHUR, TEX.—The Port Arthur Light & Power Company, controlled by the Stone & Webster Management Association, Boston, Mass., is contemplating extensive additions to its electric generating station, which will include the erection of a new building, 97 ft. by 46 ft., 50 ft. high, served by a 40-ton electric traveling crane; circulating water tunnels for supplying and discharging water to condensing plant; erection of concrete stack, 10 ft. in diameter, 200 ft. high. The equipment will include a 4000-kw. horizontal steam turbine, with surface condenser and auxiliary pumps; steam will be supplied by two 600-hp. water tube boilers arranged for oil burning equipment with necessary auxiliary pumps for feed water purposes, switchboard equipment and transformers necessary to make connections to existing service.

WICHITA FALLS, TEX.—The Wichita Falls Electric Company contemplates extending its transmission lines to Henrietta, a distance of 18 miles.

Pacific States

PUGET SOUND (BREMERTON P. O.), WASH.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 19 for furnishing and installing an alternator in connection with an engine furnished by the government; boilers, condensers, pumps, motors, switchboard, equipment, piping, wiring, lighting, etc., for the heating and power plant at the naval torpedo station, Puget Sound, Wash. Drawings and specifications may be obtained upon application at the above bureau or to the commandant of the navy yard named.

SEATTLE, WASH.—The Aero Alarm Company, recently incorporated, has announced that it has purchased the controlling interest in the Instantaneous Alarm Company, which owns the stock of the American District Telegraph Company of Seattle. This gives the Aero company important franchise privileges, including direct electrical connection with the headquarters of the Seattle Fire Department, the American District Telephone Company having underground conduits in the principal parts of the city. Fire and burglar alarms, watchman supervision and messenger service will be included.

SEATTLE, WASH. — The contest between the city of Seattle and the American Nitrogen Products Company for the Sauk-Suiattle power site in Snohomish and Skagit Counties has been decided in favor of the company, which will develop the same. The initial cost is estimated from $1,000,000 to $5,000,000; the ultimate development will require an expenditure of $25,000,000 or more. The company, it is understood, will begin investigation work at once, with a view of actual development, beginning with 10,000 hp., which will ultimately be increased to 250,000 hp. The first development, it is understood, will be located near the town of Derringer. C. F. Graff, Securities Building, Seattle, Wash., is president and general manager of the company.

SPOKANE, WASH.—Preliminary work has been completed for a hydroelectric development on the Pend Oreille River, about 125 miles north of Spokane. The proposed project will consist of a dam 375 ft. high above the bed of river and about 250 ft. long at crest. Hugh Cooper, 101 Park Avenue, New York, N. Y., is engineer.

TACOMA, WASH.—Tentative plans have been prepared by the City Council involving an expenditure of more than $2,000,000 by the city of Tacoma for the acquisition and development of an additional hydroelectric power plant, or $300,000 for the construction of an auxiliary steam station to the present municipal system to meet the estimated demand for energy to be supplied to the proposed army post at American Lake, and for various shipbuilding concerns in Tacoma. H. F. Gronen, commissioner of light and water, has asked the Council for permission to employ a special engineer to work out plans for the proposed addition to power station.

VANCOUVER, WASH.—The Standard Electric Power & Chemical Company, recently incorporated with a capital stock of $40,000,000, proposes to develop water power sites on the Deschutes River and transmit the energy to Vancouver and establish a nitrate producing plant here. Work will not begin until next summer.

MOLALLA, ORE.—The property of the Molalla Electric Company has been purchased by E. G. Robinson, of Canby, Ore. The company furnishes electrical service to the towns of Canby, Barlow, Aurora, Hubbard and Donald. E. G. Robinson is president and manager of the company.

FRESNO, CAL.—At a mass meeting held recently the landowners of Fresno County voted approval of plans to construct a reservoir at Pine Flat, at a cost of $9,000,000, to supply water to irrigate 1,000,000 acres in Fresno, Tulare and Kings Counties. A committee will be named to ascertain if the Fresno Irrigation District desires to enter the project. Hydroelectric power for drainage will also be developed.

KESWICK, CAL.—The Northern California Power Company of San Francisco is contemplating the erection of a 60,000-volt transmission line from Keswick to French Gulch, a distance of 15 miles, in the spring. The 60,000-volt line from the Balakala Mine to Gladstone and thence to French Gulch, 8 miles long, will be taken down.

MARE ISLAND, CAL.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 20 for furnishing miscellaneous quantity of electric cable, conductors and wire at Mare Island, Cal., under Schedule 628.

SAN DIEGO, CAL.—County Board of Supervisors has awarded the franchise to construct and operate electric lines along certain highways in Orange County to the Consolidated Gas & Electric Company.

SAN FRANCISCO, CAL.—The Public Utilities Committee of the Board of Supervisors has authorized the construction of a municipal railway on Market Street from the Ferry through the Twin Peaks Tunnel to Sloat Boulevard and connection with the Church Street line. The cost is estimated at $655,000.

SAN FRANCISCO, CAL.—The fourth high-tension transmission line of the Sierra & San Francisco Power Company of San Francisco will be erected to connect with the 204,000-volt transmission line reaching San Francisco from the power plant of the company on the head waters of Stanislaus River. The new 60,000-volt line will connect with the transmission line at Manteca and will tap territory south of there. The cost of the work is estimated at $36,000. The company will also erect a new substation at Oakdale, to cost about $10,000.

SONORA, CAL.—An election will be called to vote on the proposal to issue $20,000 in bonds for the construction of a municipal electric-lighting system. Wires will be placed underground.

JULIAETTA, IDAHO.—Improvements are being made to the plant of the Juliaetta Milling Company. The flat rate will be discarded and meters installed and a day service established. F. C. Holbrook is owner and manager.

YUMA, ARIZ.—The City Council has engaged F. E. Trask, engineer, Union Trust Building, Los Angeles, Cal., to prepare estimates of cost of construction of a municipal electric-light and water-works system.

BILLINGS, MONT.—The Town Board has engaged the Mackintosh-Walton Company, consulting engineers, of Oklahoma City, to prepare plans for extensions to the municipal water and light plant. The proposal to issue bonds for the proposed work will soon be submitted to the voters.

GREAT FALLS, MONT.—Bids will be received by the City Council of Great Falls, Mont., until Feb. 20 for a motor-driven combination street sprinkler and sweeper. Bids to be addressed to W. H. Harrison, city clerk.

Canada

EDMONTON, ALTA.—The Edmonton Power Company, it is reported, is making surveys for the construction of a railway (80 miles long) from Edmonton to its new power plant site. Work will begin on the construction of the power plant as soon as the railway is completed, which, it is estimated, will take about a year. E. W. Bowness is manager and engineer.

BRANTFORD, ONT.—The City Council is considering the question of developing a hydroelectric plant on the Grand River. H. F. Leonard is city clerk.

BRANTFORD, ONT.—The Brantford Hydro-Electric Power Commission has been authorized to remodel and extend its distribution lines, to be purchased, and to supply electrical service to the districts of Grandview, Exchange Place and Parkdale.

TORONTO, ONT.—Tenders will be received by the Chairman of the Toronto Electric Commissioners, Toronto, until March 28 for synchronous condensers. Specifications may be obtained at the office of the purchasing agent, 15 Wilton Avenue, Toronto.

TORONTO, ONT.—A permit has been secured by the British Forgings Company to put in foundations for an electric plant at the foot of Cherry Street, near the Harbor Commission's ground area, for the Imperial Munitions Board. The cost of the plant is estimated at $25,000.

ALTON, QUE.—The by-law authorizing the installation of hydroelectric power was carried.

MONTREAL, QUE.—Tenders will be received by Norcross Brothers, 10 Cathcart Street, contractors for the construction of the temporary station for the Canadian Northern Railway Company, for roofing, electrical work, heating, plumbing, plastering, excavating and structural concrete and purchase of 100 tons of reinforcing steel; also tiles and paving blocks, to cost approximately $150,000.

VERDUN, QUE.—The city of Verdun has received authority from the Legislature to expend $250,000 for the installation of underground conduits. A. S. Claeson is city engineer.

14,256. INSULATOR; William H. Williams, Carey, Ohio. App. filed Sept. 19, 1916. Designed to hold one or more wires, and to hold wires which cross each other at an angle.

1,214,500. ANODE FOR VACUUM DISCHARGE -TUBES; Charles Frederick William Bates, Cleveland, Ohio. App. filed Aug. 17, 1915. Anodes or targets for tubes.

1,214,511. TELEPHONE SWITCHING SYSTEM; Henry Peter Clausen, Mount Vernon, N. Y. App. filed June 7, 1915. Cord circuit for manual systems.

1,214,512. TELEPHONE SWITCHING SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Sept. 2, 1916. Manual type.

1,214,515. SWITCH-SELECTOR; Oscar A. Danielson, New York, N. Y. App. filed Nov. 2. 1914. For use in keyboard transmitters for printing telegraph systems.

1,214,528. ELECTRIC SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed Jan. 2, 1915. Provision of an important controlling apparatus.

1,214,540. ELECTRICALLY OPERATED TABULATING AND LIKE MACHINE; Christian Augustine Everard Alfred Greene, London, England. App. filed Nov. 15, 1915. Improvements.

1,214,591. ANTENNA FOR RADIOTELEGRAPH STATION; Gustav Reuthe, Sayville, N. Y. App. filed April 29, 1916. Use a transmitting antenna having a counterpoise and divides the counterpoise into individual sectors which can be separated electrically from each other.

1,214,610. TELEPHONE RECEIVER; Naho Tannaka, New York, N. Y. App. filed Sept. 30, 1915. Diaphragms are cushioned.

1,214,613. VAPOR ELECTRIC APPARATUS; Percy H. Thomas, Upper Montclair, N. J. App. filed Sept. 12, 1912. Such as can be successfully operated on a constant-current circuit.

1,214,615. ELECTRICALLY CONTROLLED BRAKE; Walter V. Turner, Edgewood, Pa. App. filed Oct. 3, 1914. Means for limiting the maximum rate of reduction in brake pipe pressure to a predetermined degree.

1,214,616. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Edgewood, Pa. App. filed Oct. 3, 1914. To an equipment in which the brakes are applied by electrically venting fluid from the brake pipe.

1,214,620. MEANS FOR PRODUCING ELECTRICAL OSCILLATIONS WITH THE AID OF AN AUXILIARY OSCILLATION CIRCUIT; George von Arco and Alexander Meissner, Berlin, Germany. App. filed Sept. 17, 1912. Improvements.

1,214,624. ALARM FOR RAILROAD CROSSINGS; Beecher D. Whitcomb, Shawomet, R. I. App. filed July 26, 1915. Novel means for controlling the return of the core to normal position.

1,214,638. SELECTIVE LOCKOUT TELEPHONE SYSTEM; Frank W. Adsit, St. Paul, Minn. App. filed June 30, 1914. Improvements.

1,214,644. ELECTRIC LIGHT SOCKET; Tonjes August Carl Both, Malden, Mass. App. filed April 16, 1912. Mechanical movement adapted for universal application.

1,214,647. BATTERY CELL; Campbell C. Carpenter and Roy J. Ellis, Niagara Falls, N. Y. App. filed April 6, 1916. The cover being so designed as to effectually cover and seal the jar.

1,214,652. LIGHTNING-ROD STRUCTURE; John E. Curti, Omaha, Neb. App. filed April 3, 1916. For connecting the standard with the horizontal cable.

1,214,655. WIRELESS-TELEPHONE APPARATUS; Burr V. Deitz, Slingerlands, N. J. App. filed Oct. 15, 1913. For changing alternating to a direct current.

1,214,663. MOTOR-CONTROLLER; Clarence T. Evans, Milwaukee, Wis. App. filed May 2, 1914. Improved circuit arrangement.

1,214,669. BATTERY CELL; Julius M. Gauss, Niagara Falls, N. Y. App. filed April 8, 1916. Liability of adding too much liquid is minimized.

1,214,686. SUPERVISORY SYSTEM; Alexander E. Keith, Chicago, Ill. App. filed May 14, 1907. Automatic or semi-automatic telephone exchange systems.

1,214,694. TELEPHONE SYSTEM; Albion D. T. Libby, Elyria, Ohio. App. filed Jan. 9, 1911. Telephone meter systems.

1,214,718. OVERLOAD CIRCUIT OPENER; Edmund O. Schweitzer, Chicago, Ill. App. filed April 21, 1913. Improvement.

1,214,721. SIGNAL; William Sparks, Jackson, Mich. App. filed Oct. 8, 1915. Cam actuated diaphragm type.

1,214,722. SIGNAL; William Sparks, Jackson, Mich. App. filed Nov. 18, 1915. Diaphragm signals.

Record of Electrical Patents

Notes on United States Patents issued on Feb. 6, 1917.

1,214,745. HOIST BLOCK; Clement E. Beard, Columbiana, and Walter G. Stephan, Cleveland, Ohio. App. renewed June 29, 1915. Weight indicating or measuring means.

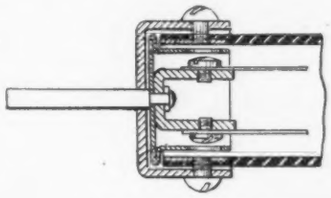
1,214,752. ELECTRIC SWITCH; Harry R. Canfield, Ohio. App. filed Feb. 9, 1911. Magnetically operated.

1,214,757. ELECTRIC WATER HEATER AND AUTOMATIC CONTROL; Dudley B. Clark, Bemus Point, N. Y. App. filed May 9, 1916. Combined hydraulic electrical control.

1,214,763. ELECTRICALLY HEATED STEEL FURNACE; Joseph Lawton Dixon, Detroit, Mich. Improvements.

1,214,764. ELECTRIC STEEL FURNACE; Joseph Lawton Dixon, Detroit, Mich. App. filed Oct. 14, 1916. Regulation of the positions of the electrodes, either automatically or by hand may be rendered more simple and certain.

1,214,770. PROCESS OF MAKING CYANOGEN COMPOUNDS; Hans Foersterling and Herbert Philipp, Perth Amboy, N. J. App. Renewed June 21, 1916. Vaporizing a metal capable of forming cyanogen compounds and reacting the vaporized metal with nitrogenous and carbonaceous matter.



1,214,903. Fuse.

1,214,775. ELECTROLYTIC APPARATUS; William E. Greenawalt, Denver, Col. App. filed Aug. 18, 1913. Electrode bell.

1,214,779. ELECTRIC SWITCH; Jay H. Hall, Cleveland, Ohio. App. filed Feb. 2, 1913. Magnetically operated.

1,214,808. METHOD OF REDUCING METALS; Robert J. McNitt, Niagara Falls, N. Y. App. filed May 12, 1915. From compounds containing the same.

1,214,816. ELECTRIC LAMP; Moses Solomon Okun, New York, N. Y. App. Renewed June 22, 1916. Great percentage of electric energy is transferred into light.

1,214,817. MEANS FOR EFFECTING MAGNETIC OR INDUCTIVE SEPARATION OF SUBSTANCES; Samuel W. Osgood, Chicago, Ill. App. Renewed June 30, 1916. Improvements.

1,214,830. MOISTURE-PROOF SWITCHBOARD CORD; William L. Runzel, Chicago, Ill. App. filed May 24, 1915. Improved interconnecting cord.

1,214,836. BATTERY PACKAGE; John Smith, Brooklyn, N. Y. App. filed May 1, 1916. Provides a combined dry cell set and container which will be both waterproof and heat insulating.

1,214,841. ELECTRIC FURNACE FOR FUSING METALS; John Thomson, New York, N. Y. App. filed Jan. 28, 1916. High thermal economy, rapidity, convenience and metallurgical efficiency.

1,214,842. ELECTRIC ZINC-DISTILLING FURNACE AND CONDENSER FOR PRODUCING BLUE POWDER; John Thomson, New York, N. Y. App. filed Jan. 28, 1916. Increase the purity and effectiveness of the said material at a minimum cost of production.

1,214,857. TRAIN-COUPLING FOR ELECTRICAL CONDUCTORS; Walter C. White, Los Angeles, Cal. To retain the terminals of the electrical conductors within the coupler heads.

1,214,879. ELECTRIC-CIRCUIT-PROTECTING FUSE; Sydney N. Baruch, San Francisco, Cal. App. filed Aug. 25, 1915. Fusible element.

1,214,883. ALTERNATING-CURRENT MOTOR; Donald M. Bliss, West Orange, N. J. App. filed March 13, 1911. Adapted to be operated from a single-phase alternating-current circuit.

1,214,900. SOCKET FOR ELECTRIC LAMPS; John Cuthbert, Chicago, Ill. App. filed Dec. 2, 1915. Easily wired.

1,214,903. FUSE; Louis W. Downes and Ralph Clifton Patton, Providence, R. I. App. filed Oct. 23, 1915. Designed to open the circuit when an excessive current passes through the line.

1,214,915. SERVICE-BOX AND SWITCH; Morton Havens, Jr., and Francis R. Meginniss, Albany, N. Y. App. filed Aug. 18, 1913. For preventing the removal of a burnt-out fuse without first operating the switch to break the circuit.

1,214,920. ELECTRIC SWITCH; Newman H. Holland, West Orange, N. J. App. filed Feb. 16, 1914. Contacts normally spaced apart.

1,214,934. ELECTROLYTIC GAS GENERATOR; Isaac H. Levin, New York, N. Y. App. filed Dec. 20, 1915. To produce hydrogen and oxygen gases.

1,214,956. INSULATOR; Charles W. Rogers, Exeter, N. H. App. filed June 5, 1914. For insulating swaying electric wires from trees.

1,214,959. ILLUMINATED FOUNTAIN PEN; Edmund O. Schaffer, Derby, Conn. App. filed June 27, 1916. The lamp not interfering in any way with ordinary use of the pen.

1,214,969. MEASURED-SERVICE TELEPHONE SYSTEM; Samuel S. Stolp, Chicago, Ill. App. filed Feb. 29, 1912. Improvement.

1,214,980. ALTERNATING-CURRENT MOTOR; Hans Weichsel, St. Louis, Mo. App. filed April 12, 1915. Single-phase asynchronous induction motors having a shunt characteristic.

1,214,982. AUTOMATIC TELEPHONE SYSTEM; Charles S. Winston, Chicago, Ill. App. filed April 11, 1910. System which is free from ground connection at the subscribers' stations.

1,214,983. METAL-WORKING MACHINE; Edward V. Wurts, Pittsburgh, Pa. App. filed Jan. 28, 1914. Improvements.

1,214,989. AUTOMATIC TELEGRAPHIC OR RADIOTELEGRAPHIC TRANSMITTER; Edouard Belin, Paris, France. Improvements.

1,215,002. TELEPHONE APPARATUS; Eldridge A. Cox, Dayton, Ohio. App. filed March 6, 1916. May be connected with, or disconnected from, the central station without touching the receiver.

1,215,004. BATTERY CONNECTOR; Spencer M. Decker, Malden, Mass. App. filed April 21, 1916. Plurality of dry cells may be connected together.

1,215,037. SIGNAL FOR AUTOMOBILES; David J. Lanehart, Baltimore, Md. App. filed May 16, 1916. Readily observable both by night and day.

1,215,038. TELEPHONE-CIRCUIT ARRANGEMENTS; Charles D. Lanning, Boston, and Stephen C. Drew, Brookline, Mass. App. filed Aug. 2, 1911. Concerned wih the relation of two voice current circuits inductively connected.

1,215,042. AUTOMATIC SIGNAL DEVICE; George C. Martin, Los Angeles, Cal. App. filed April 2, 1913. Useful in connection with railway crossings and the like.

1,215,060. TELEPHONE HEAD-GEAR; Thomas Rhodus, Chicago, Ill. App. filed Oct. 7, 1915. Holder is formed of semicircular spring bands.

1,215,070. STREET CAR AND RAILWAY INDICATOR; Ernest H. Stacy, Atlanta, Ga. App. filed April 12, 1916. Improvements.

1,215,074. INSULATING GAS-TIGHT SEAL; William E. Story, Jr., Schenectady, N. Y. App. filed Sept. 19, 1914. Construction of vacuum-tight insulating seals.

1,215,077. MACHINE FOR WATERPROOFING FIBROUS MATERIALS; Alfred O. Tate, Montreal, Quebec, Canada. App. filed Feb. 20, 1915. For producing waterproofed paper.

1,215,079. CANDELABRUM SOCKET; George B. Thomas, Bridgeport, Conn. App. filed Feb. 16, 1916. Lining for the socket.

1,215,088. END RING FOR SQUIRREL-CAGE WINDINGS; Francis M. Whitney, San Diego, Cal. App. filed May 28, 1914. Method of applying.

1,215,094. SYSTEM OF SHIP PROPULSION; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed April 26, 1913. Propellers are driven by induction motors supplied with alternating current from a polyphase alternator.

1,215,095. SYSTEM OF SHIP PROPULSION; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Oct. 13, 1916. In which the ship's propellers are driven by electric motors.

1,215,116. X-RAY APPARATUS; William D. Collidge, Schenectady, N. Y. App. renewed Oct. 24, 1916. Increased capacity is provided by rotating the tube as a whole and deflecting the cathode beam out of line with the axis of rotation.

1,215,118. ELECTRIC LAMP; Albert Dow Cox, Winterville, N. C. App. filed Dec. 22, 1915. Two separate resistance or light-giving circuits.

1,215,141. ELECTRIC-LAMP SOCKET; George W. Goodridge, Bridgeport, Conn. App. filed Sept. 14, 1916. Improved construction of the insulating body.

1,215,147. ARC-LAMP; Cromwell A. B. Halvorson, Jr., Saugus, and Walter L. Harraden, Lynn, Mass. App. filed March 1, 1913. Mounted upon a standard or other support.

1,215,150. ELECTRICAL TESTING APPARATUS; Allan B. Hendricks, Jr., Pittsfield, Mass. App. filed April 9, 1915. Oils and other liquids.

1,215,155. AUTOMOBILE SIGNAL; Charles McKeon Hosford, Brooklyn, N. Y. App. filed May 4, 1915. Automatically operated by a steering wheel.

1,125,169. SIGNALING DEVICE; George John Kloepfer and Carl F. Kloepfer, Springfield, Ohio. App. filed July 26, 1916. For use with motor vehicles.

1,210,540. CATHODE RAY TUBE; H. E. R. Rukop and W. K. M. Schloemilch, Berlin, Germany. App. filed Oct. 28, 1915; issued Jan. 2, 1917. A high-vacuum hot-cathode tube of the audion type, in which the relative positions of the grid and plate electrodes are fixed by insulating members and which has a glowing filament in a plane perpendicular to those of the grid and plate.

1,210,678. THERMIONIC AMPLIFIER; A. McL. Nicolson, New York, N. Y. App. filed May 19, 1915; issued Jan. 2, 1917. An amplifier of the audion type, in which the electronic stream is augmented by providing auxiliary cathodes which are heated by bombardment of electrons from the filament and which give off additional electrons.

1,211,754. CRYSTAL RECTIFIER; P. C. Rawls, Des Moines, Iowa. Original app. filed July 6, 1914; divided Dec. 30, 1914; issued Jan. 9, 1917. Details of mounting for crystal detector, in which two springs oppose each other, the second being capable of applying a lateral tension to the crystal contact. Shows a flat-polished crystal surface with regular projections produced by cross grooves.

1,211,770. MICROMAGNETIC DETECTOR; F. G. Simpson, Seattle, Wash. Original app. filed Nov. 1, 1912; divided April 23, 1913; issued Jan. 9, 1917. Group tuned magnetic detector, in which the effect of incoming wave trains is directly to produce movement in a pair of tuned vibrating wires. The motions so set up are caused to affect a microphonic contact connected in series with a battery and indicating instrument.

1,211,863. APPARATUS FOR AND METHOD OF PRODUCING HIGH-FREQUENCY CURRENTS OF ELECTRICITY; D. G. McCaa, Lancaster, Pa. App. filed Sept. 24, 1913; issued Jan. 9, 1917. Generator of substantially sustained, or high-group frequency, waves for radiotelephony or the like, in which the primary oscillatory circuit contains a large capacity series condenser to prevent arcing at the quenched spark gap.

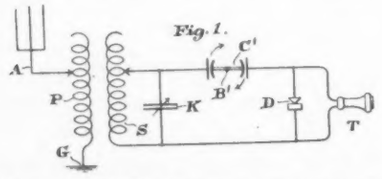


Fig. 1—Proctor's Receiver for Undamped Waves

1,211,963. RADIO RECEIVING APPARATUS; J. A. Proctor, Revere, Mass. App. filed June 29, 1914; issued Jan. 9, 1917. Receiver for continuous oscillations, in which either a tuning or a blocking condenser is varied in capacity periodically, so as to produce oscillation variations corresponding to the desired tone frequency.

1,212,163. RELAY FOR UNDULATORY CURRENTS; E. M. C. Tiegerstedt, Copenhagen, Denmark. App. filed Oct. 19, 1916; issued Jan. 9, 1917. An audion-type amplifier in which a central filament is surrounded by a perforated cylindrical "auxiliary anode" or grid electrode, which in turn lies within a spiral anode or plate electrode. The whole is inclosed by a magnetic and static shielding case.

1,212,202. SUBMARINE, SUBTERRANEAN AND AERIAL TELEPHONE; R. A. Fessenden, Brookline, Mass. App. filed May 12, 1916; issued Jan. 16, 1917. A radio-frequency alternator, a magnetic amplifier output circuit, a rectifier and the control coil of a large "oscillator" or powerful telephone receiver are serially connected so that voice vibrations acting through the magnetic amplifier will produce intense corresponding vibrations of the "oscillator" diaphragm. These are used for acoustic transmission to comparatively long distance through the air, earth or water.

1,213,066. WIRELESS AUTOMATIC RAILWAY REGISTERING SYSTEM; C. L. Bopp, Waterloo, Iowa. App. filed Feb. 24, 1913; issued Jan. 16, 1917. Wireless telegraph apparatus using coherers and relays, controlled by the passage of a train over predetermined portions of track. This device is used in train and block-signal systems, in conjunction with wire telegraphs.

Recent Radio Patents

Notes and Comments on United States Patents on Radio Signaling and allied topics issued during January, 1916.

1,213,250. MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES; G. W. Pickard, Amesbury, Mass. Original app. filed Aug. 30, 1906; divided Nov. 8, 1906; issued Jan. 23, 1917. Receiver in which are combined an antenna system, a high-resistance good-contact rectifier, a direct-current indicating device and a shunting condenser for the purpose of leading oscillation current groups to the rectifier and around the indicator.

1,213,869. INDUCTANCE COIL; D. R. Price, Winthrop, Mass. App. filed April 24, 1914; issued Jan. 23, 1917. An inductance coil for radio-telegraph or wire circuits, in which the resistance to fluctuating currents is minimized by compensating for the varying impedance effects produced by inequalities in length of the insulated strands of wire used in winding.

1,214,022. APPARATUS FOR WIRELESS TELEGRAPHY AND THE LIKE; P. E. Edelman, Minneapolis, Minn. App. filed Aug. 19, 1912; issued Jan. 30, 1917. Details of apparatus for selective transmission of radio messages, dependent upon successive choice of wave and group frequencies or upon intervals between impulses, or combinations of these. Includes various forms of receiving tuning apparatus, a multi-contact crystal detector, etc.

1,214,214. GENERATOR OF HIGH-FREQUENCY CURRENTS; P. O. Pedersen and V. Poulsen, Frederiksberg, Denmark. App. filed Jan. 6, 1913; issued Jan. 30, 1917. System of paralleling arc generators for production of high-power oscillations. The usual phase difficulties of parallel arcs are avoided by dividing the oscillation circuit and placing a series condenser and inductance in each branch.

1,214,265. DETECTOR FOR WIRELESS SYSTEMS; M. Berel and L. Funke, New York, N. Y. App. filed March 11, 1916; issued Jan. 30, 1917. A crystal detector which is hermetically sealed after proper adjustment of contact is effected, so as to permit indefinitely long use without readjustment.

1,214,283. WIRELESS TELEGRAPHY; L. deForest, Palo Alto, Cal. App. filed Sept. 24, 1912; issued Jan. 30, 1917. The capacity of a fan antenna is increased by locating near it a supplementary horizontal antenna, directly grounded, with the object of permitting greater energy storage without reduction of radiation resistance.

DISCUSSION

The new year begins with the issue during January, of fifteen patents having to do with radio signaling. This is in strong contrast to the three which were published in December, 1916, but of course cannot be taken as true index of inventive activity for the reason that the application dates may be from a few months to a dozen years earlier than the dates of patenting. In this month's group the Tigerstedt patent, applied for only last October, may be contrasted with the Pickard patent bearing application date of August, 1906, in order to note specific examples of the large variation in complexity presented by the work of the Patent Office.

An interesting device is shown in Fig. 2, which is reproduced from the drawings of Nicolson's patent, No. 1,211,678. This is an audion amplifier bulb of special construction, and is designed to increase the cathode stream over that which would be obtained from a simple filament. In the figure there is shown a straight-wire vertical filament 14, which may be of tungsten coated with a mixture of strontium and barium oxides. It is heated to incandescence, and thus emits a stream of electrons which are caused to bombard the "equipotential cathode" 13. This second cathode is a similarly coated tube of thin sheet platinum or tungsten, and is held at a potential positive with respect to the filament 14 by means of a special battery. The bombardment results in making the tube electrode 13 give off a powerful stream of electrons, by reason of its large surface, and so increases the energy output of the tube. The electron stream passing from the cathodes to the anode 11 is controlled by the electrostatic field of the grid or input electrode 12, which is connected in any of the usual amplifying or generating circuits. Another form of the bulb in which there are several successively larger concentric tubular cathodes is shown; in this more complex bulb each cathode bombards that next outside it, so building up the electron stream to the maximum output of the largest and outermost cathode tube.

Fig. 1 shows the circuit arrangement proposed by J. A. Proctor, in patent No. 1,211,963, for the reception of continuous or sustained waves. The antenna circuit comprises the aerial itself, *A*, the primary coil with variable contact, *P*, and the earth connection *G*. The secondary *S* has connected across its terminals the tuning condenser *K*, and this in turn is shunted by the circuit containing the detector *D*, telephones *T* and variable condenser *C'* as shown. If the condenser *C'* were set at some particular value and allowed to remain in that condition, the receiver would correspond closely to the apparatus ordinarily used for reception of groups of damped waves. In the proposed arrangement, however, the rotating element of *C'* is mounted on a shaft *B'* and is rapidly revolved so as to change the capacity smoothly from minimum to maximum at the rate of from 200 to 500 times per second. When the capacity is near zero it is obvious that oscillations cannot pass effectively from the secondary to the detector, and that, consequently, no energy can reach the telephone. When the capacity is at its maximum, however, the transfer of energy from the secondary condenser *K* to the telephone and detector combination is necessarily quite rapid. Thus there is obtained a sort of "chopper" effect which is similar to that secured by inserting an interrupter in the receiving circuit of a wireless station working with sustained waves. Because the change of capacity is gradual, and so is quite different from the sudden action of a contact device, the arrangement of Fig. 1 is said to produce a better musical note than does the simple "chopper." In operation it is desirable to adjust the speed of the condenser variations so that the tone produced corresponds in frequency to the natural period of the receiving telephone.

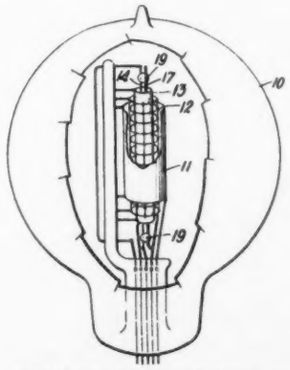


Fig. 2—Nicolson's Double-Cathode Amplifier